

**BULLETIN**  
*of the*  
**AUCKLAND INSTITUTE AND MUSEUM**

*No. 5*

**THE MOLLUSCAN FAMILIES  
SPEIGHTIIDAE AND TURRIDAE**

**An evaluation of the valid taxa, both Recent  
and fossil, with lists of characteristic species**

**by**  
**A. W. B. POWELL**



**PUBLISHED BY ORDER OF THE COUNCIL**

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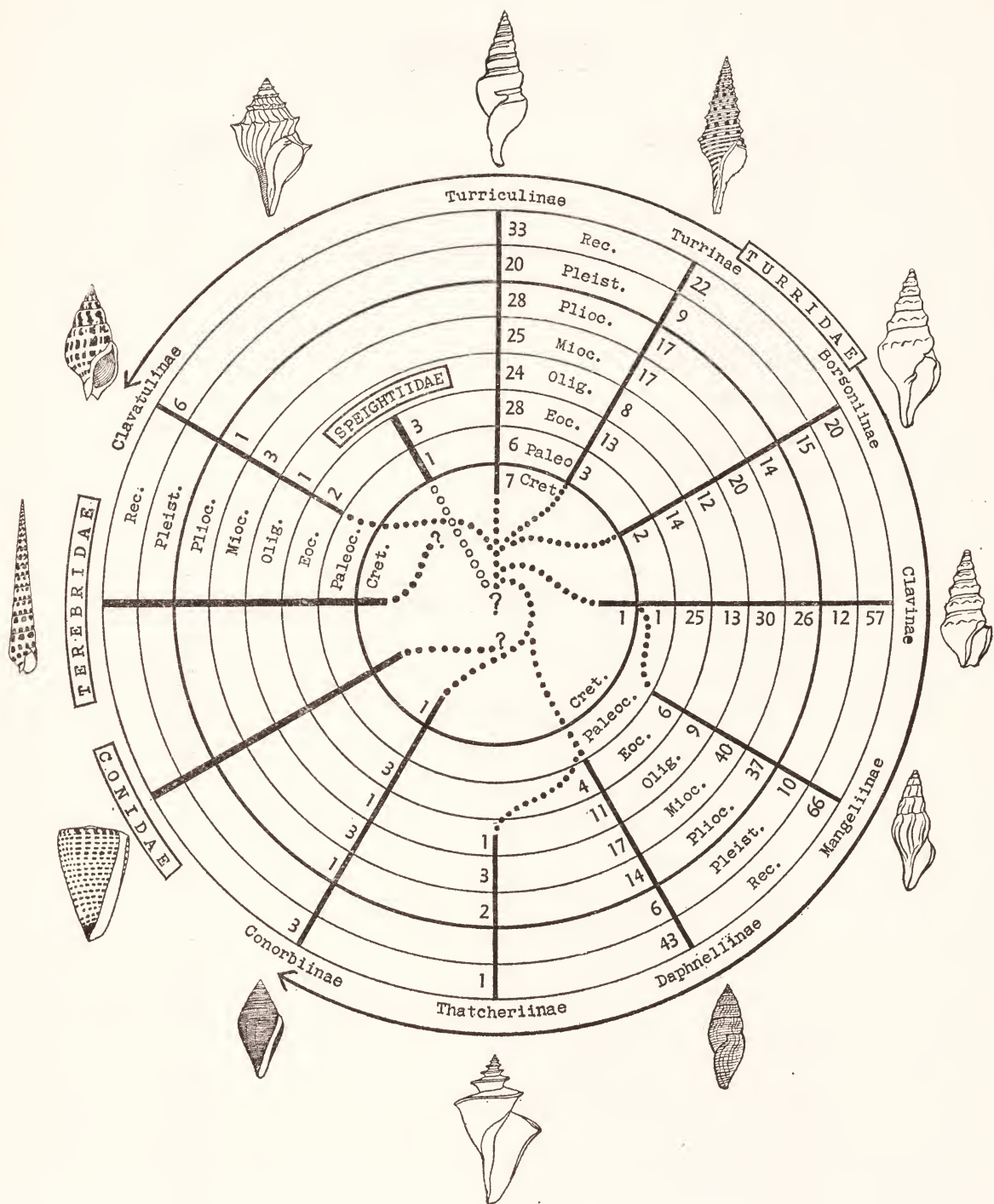
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TEXT FIGURE A1. WELL DIAGRAM OF TOXOGLOSSATE PHYLOGENY. Showing the time ranges and suggested phylogeny of the toxoglossate families Speightiidae, Turridae (nine subfamilies), Conidae and Terebridae. The figures record the number of genera referable to each turrid subfamily for all periods, ranging from the upper Cretaceous to Recent times, but earlier relationships and derivations, indicated by dotted lines, are purely conjectural.



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and fossil, with lists of characteristic species

by A. W. B. POWELL

Auckland Institute and Museum

## ABSTRACT

The purpose of this bulletin is to list and evaluate the 549 generic and subgeneric names that have been either proposed or accepted, from time to time, for use within the families Speightiidae and Turridae, to illustrate, wherever possible, the type species of each presumably valid taxon, and to provide lists of characteristic species, together with their distributional patterns, both recent and fossil.

## GENERAL DISCUSSION

The turrids comprise one of a group of four closely related families, which form the superfamily Toxoglossa, within the order Neogastropoda—(1) Speightiidae (2) Turridae (3) Conidae and (4) Terebridae.

Classification of the Turridae has been greatly hampered, and still is to a considerable extent, by several factors, the principal one being, that although species are exceedingly numerous, few are intertidal, and most occur sparsely, so that a range of specimens is not often obtainable, even by dredging. This paucity of representative live-taken material is reflected in the very few species that have been described anatomically.

In this bulletin, descriptions and figures of the radulae of 169 species of turrids are brought together, and of this number 126 are made known for the first time. This information has greatly facilitated the classification of the family by revealing some unexpected relationships, and as more species become known in this way, further taxonomic adjustments will certainly become necessary.

Many of the genera are based upon fossils, and an evaluation of these is dependent upon superficial comparison with analogous but frequently anatomically unknown Recent forms. Often such comparisons are conjectural, relying mainly upon such characters as the style of protoconch, the form and position of the labial sinus, the presence or absence of a stromboid notch, pillar—plications or plaits and varying forms of other apertural processes.

Even when the soft parts are available such usually disgnostic characters as the style of radula, form of the operculum, genitalia and cephalic features, do not present readily interpreted criteria.

The turrids are a complex, plastic, very successful group that occupies a full range of

marine habitats, covering all geographic areas from the tropics to the polar regions, and from shallow waters to the ocean deeps.

One of the few turrid species that has been the subject of a detailed anatomical investigation is *Mangelia powisiana* Dautzenberg (Robinson, 1960, Proc. Zool. Soc., 135, p. 319). Robinson found that the English species of *Mangelia* are comparable with the Conidae in that the radula is truly toxoglossate, complete with the neurotoxic apparatus, as well as a long proboscis capable of sufficient extension to harpoon prey.

These animals have a greatly coiled poison gland which opens ventrally into the oesophagus immediately posterior to the opening of the buccal sac. The poison gland is a coiled tube, and the swollen end of this gland is a propulsive organ, termed the muscular bulb, which functions in the harpooning of prey by means of poison-charged, detached radular teeth.

**PHYLOGENY OF THE TURRIDAE**—The cosmopolitan range of the Turridae suggests considerable antiquity for the family which has a known range extending back to the late Albian and late Cenomanian of the upper Cretaceous (Bald Hills, California).

Even in the Cretaceous and Paleocene, however, most of the so-called subfamilies were already represented, and this indicates an origin for the turrids at a much earlier date.

The style of radula, by the presence of marginals, suggests an origin from taenioglossid rather than rachiglossid stock, in which only laterals and the central are present (only the central in most Volutidae), but the rachiglossa are obvious derivations of the taenioglossa.

The only shell character that denotes a turrid is the presence of a well formed posterior anal sinus, and with the earlier fossil members this is often so slight that the shells concerned could be equally well determined as fasciolarid, particularly those such as the Speightiidae, in which there is a thickened pillar ridge.

Only the presence of a sinus somewhat deeper than in the fasciolarids calls for recognition of the Speightiidae as a family of turrid affinity but showing probable derivation from the Fasciolaridae.

The Speightiidae is considered to be an offshoot line that did not survive the Eocene, whilst the main line of the Turridae probably extends back through earlier Cretaceous forms,



either unknown or unrecognizable as turrids, since the one diagnostic shell character, the labial sinus, was apparently undeveloped initially.

**THE PROTOCONCH**—The protoconch in turrids varies from paucispiral to polygyrate and smooth to elaborately sculptured, either spirally or axially, with varying combinations of spirals and axials. The protoconch seems to be a valuable aid in the segregation of generic or subgeneric groups, but only one, the diagonally cancellate “sinusigera”, is narrowly diagnostic, being confined to the Daphnellinae and the Thatcheriinae, always in association with a reversed L-shaped sinus or modification of it.

The phenomenon of “turrid pairs”, in which identical looking shells have different protoconchs, i.e., *Lophiotoma-Lophioturris* and *Tomopleura-Maoritomella* is not clearly understood, but radula investigation now shows that each member of such pairs has a distinctive radula, the differentiation being, apparently, at greater than specific level, and thus justifying at least subgeneric distinction between such pairs.

In all likelihood, the size of the protoconch and its number of whorls are correlated with the length of the free-swimming stage of the veliger. A protoconch of few, rapidly-expanding whorls suggests a short free-swimming life, while one of several slowly-expanding whorls or one with a sinusigerous-like outer lip suggests a long-living, and hence far-travelling larval life.

**THE OPERCULUM**—The turrid operculum is horny, and either leaf-shaped to sub-ovate, with a terminal nucleus, or ovate to sub-ovate,

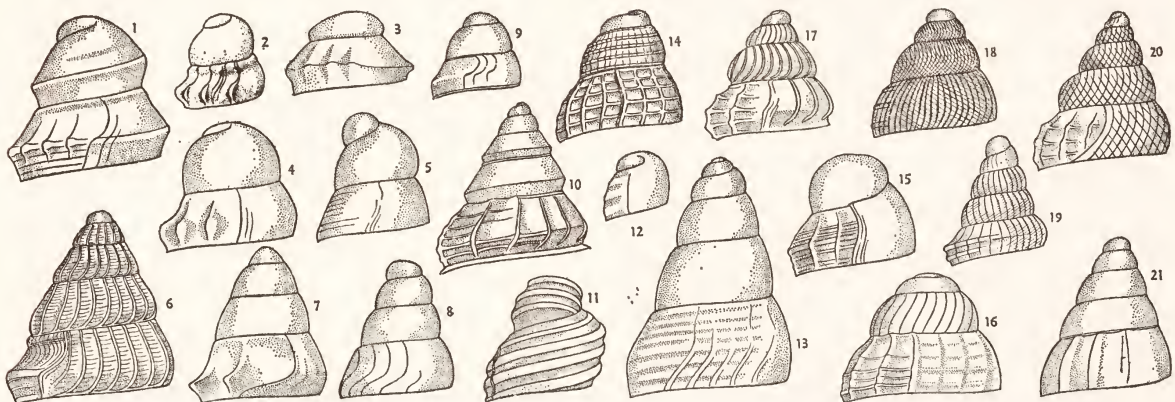
with a medio-lateral nucleus. The operculum is either absent or reduced to vestigial size in the Mangeliinae and Daphnellinae.

In my 1942 Bulletin No. 2 (Auckland Institute & Museum, p. 27) the value of the operculum as a character of taxonomic importance was discounted and instances were cited in support of a concept that the form of the operculum is consequent to the shape of the aperture, on the assumption that opercular growth takes the most convenient form to fill the apertural space.

The above concept may apply in some, but certainly not in all cases, for in quite slender species of *Turricula*, such as *catena* (Reeve) and *navarchus* (Melvill & Standen), the operculum is clavatulid, with a medio-lateral nucleus, yet upon apertural shape one would expect it to be leaf-shaped with a terminal nucleus.

We still do not know how widely separated morphologically are the genera *Turricula* and *Comitas*, which are alike conchologically but dissimilar in their opercula.

**THE LABIAL SINUS**—The turrid sinus varies from slight, almost imperceptible, to a deep narrow slit. It is situated on the peripheral keel, or on a minor spiral rib immediately above there, in the Turrinae, and also in a few members attributed to the Borsoniinae, i.e., *Paraborsonia*. In the Daphnellinae the sinus is sutural, varying from slight to very deep, and in the form of a reversed “L”, i.e., descending vertically from the suture, then produced tangentially forward. When a parietal tubercle is present the top of the sinus may be drawn forward also. In the remaining subfamilies the sinus is subsutural, broadly concave to U-shaped, sometimes rendered sub-



**TEXT FIGURE A2. TURRID PROTOCONCHS.** 1. *Paracomitas castlecliffensis* (Marshall & Murdoch). 2. *Turricula javana* (Linnaeus). 3. *Anticomitas vivens* Powell. 4. *Splendrillia aoteana* Finlay. 5. *Cryptoconus lineolatus* (Lamarck). 6. *Microdrillia pakaurangia* Powell. 7. *Austroclavus finlayi* Powell. 8. *Phenatoma rosea* (Quoy & Gaimard). 9. *Etrema aliciae* (Melvill & Standen). 10. *Eremopsis erecta* Powell. 11. *Liracraea epentroma* (Murdoch). 12. *Maorimorpha suteri* (Murdoch). 13. *Zemacies hamiltoni* (Hutton). 14. *Neoguraleus murdochii* (Finlay). 15. *Antiguraleus otagoensis* (Powell). 16. *Vexiguraleus clifdenensis* Powell. 17. *Heterocithara mediocris* Odhner. 18. *Daphnella cancellata* Hutton. 19. *Veprecula cooperi* Mestayer. 20. *Maoridaphne clifdenica* (Laws). 21. *Rugobela tenuilirata* (Suter).





TEXT FIGURE A3. LABIAL PROFILES AND APERTURAL FEATURES. 1. *Turris babylonica* (Linnaeus). 2. *Lophiotoma acuta* (Perry). 3. *Polystira barretti* (Guppy). 4. *Gemmula kieneri* (Doumet). 5. *Eoturris complicatus* (Suter). 6. *Echinoturris finlayi* (Powell). 7. *Xenoturris cingulifera* (Lamarck). 8. *Epidirona hedleyi* Iredale. 9. *Taranis nexilis bicarinatus* (Suter). 10. *Turricula tornata* (Dillwyn). 11. *Comitas fusiformis* (Hutton). 12. *Anticomitas vivens* Powell. 13. *Zemacies elatior* Finlay. 14. *Knefastia olivacea* (Sowerby). 15. *Paracomitas castlecliffensis* (Marshall & Murdoch). 16. *Acamptogenotia intorta* (Brocchi). 17. *Belophos woodsi* (Tate). 18. *Austrotoma minor* (Finlay). 19. *Megasurcula carpenteriana* (Gabb). 20. *Marshallaria spiralis* (Allan). 21. *Marshallena neozelanica* (Suter). 22. *Notogenota goniodes* (Suter). 23. *Cochlespiropsis engonata* (Conrad). 24. *Parasyrinx alta* (Harris). 25. *Ancistrosyrinx radiata* Dall. 26. *Clavatula asperulata* (Lamarck). 27. *Perrona jouanneti* (Desmoulins). 28. *Pusionella nifat* (Bruguère). 29. *Conorbis dormitor* (Sowerby). 30. *Cryptoconus filiosus* (Lamarck). 31. *Genota ramosa* (Basterot). 32. *Phenatoma rosea* (Quoy & Gaimard). 33. *Ophiodermella incisa* (Carpenter). 34. *Mitrellatoma angusta* (Hutton). 35. *Inquisitor problematica* (Powell). 36. *Clavatoma pulchra* Powell. 37. *Aoteadrillia wanganuiensis* (Hutton). 38. *Mauidrillia praecophinodes* (Suter). 39-40. *Borsonia prima* Bellardi. 41. *Cordieria rudis* (Hutton). 42. *Borsonella dalli* (Arnold). 43. *Scobinella magnifica* (Gabb). 44. *Eoscobinella tahuia* Powell. 45. *Mitriothara alba* (Petterd). 46. *Guraleus pictus* (Adams & Angas). 47. *Heterocithara bilineata* (Angas). 48. *Etrema aliciae* (Melvill & Standen). 49. *Etrema curtisiana* Hedley. 50. *Eucithara brocha* Hedley. 51. *Anacithara naufraga* (Hedley). 52. *Daphnella cancellata* Hutton. 53. *Asperdaphne versivestita* (Hedley). 54. *Stilla flexicostata* (Suter). 55. *Cryptodaphne pseudodrillia* Powell. 56. *Nepotilla vera* Powell. 57. *Philbertia philberti* (Michaud). 58. *Kermia benhami* Oliver. 59. *Rugobela tenuilrata* (Suter). 60. *Eubela limacina* (Dall).



tubular by the presence of a strong parietal tubercle.

A curious feature found in *Gemmula hombroni* Hedley and sometimes in *G. graeffei* (Weinkauff) is the formation of a second sinus, situated in the lower outer lip at the position occupied by the stromboid-notch, when one is present. This feature can be seen in an incipient form in most examples of the above-mentioned species but occasionally this second sinus is well formed, almost a replica of the true sinus.

The purpose of this second sinus is conjectural, and the living animal would need to be studied to determine its exact purpose. Retracted preserved material throws no light upon the problem.

Tucker Abbott (1960, Indo-Pacific Mollusca, 1, no. 2, p. 33) interpreted the true stromboid-notch (i.e. in *Strombus*) as a "peep hole" for the protruding right eye. Alternatively the notch could be a copulatory aid, which seems to have been convincingly established as such, for a similar structure, in the case of the Cuban helicininid land snail genus *Eutrochatella*.

The extra sinus does not seem to be quite comparable with the irregular flutings often found in *Gemmula* and the related genera *Pinguigemmula* and *Ptychosyrinx*. In all cases the flutings have a projecting rounded or spout-like termination, and almost invariably they are filled with callus. The solid nature of these flutings negatives the suggestion made by Mac Neil (1960, U.S. Geol. Surv. Prof. Paper 339, p. 104) that they may represent a response to an oxygen-poor environment, in which one or more incurrent siphons are developed.

**THE RADULA**—The radula in the Turridae is of several types, ranging from a prototypic form, with central, lateral and marginal teeth, through a series characterized by the absence of laterals, but with, in many instances, a compensating enlargement of the central tooth, to finally the true toxoglossate state, in which only the marginals, one on each side, remain. These marginals may be stout to slender, symmetrically arranged and weakly attached to the lingual ribbon, or they may be long, slender and barbed, detached, and housed like a bundle of arrows, in the radula sac.

Collation of the published figures of turrid radulae, plus a large number of unpublished drawings, prepared by Dr. J. P. E. Morrison of the United States National Museum, and augmented by many drawings of preparations made for me by Mr W. F. Ponder of Auckland, has resulted in the elucidation of several apparent anomalies, that previously hampered a satisfactory understanding of the taxonomic significance of the turrid radula.

An important fact is evident, which is, that no turrid, so far dissected by Ponder, is with-

out a well developed poison gland, not even the so-called prototypic radula. Risbec (Journ. de Conchyl., 95, 2, p. 82, figs. 18 & 21) (not fig. 20, error for fig. 18) also showed a poison gland coupled with a prototypic radula for the Indo-Pacific "*Drillia auriculifera* Lamarck" = *Clavus canicularis* Röding.

Another important observation is that the radula of the Turrinae does not invariably consist of a pair of wishbone-shaped marginals, for a central, either vestigial, or in some cases very large and well formed, may be present also.

Striking instances of the presence of a large central with a laterally spreading base, in association with wishbone marginals are found in the turrid species *Gemmula gilchristi* Sowerby, *Turris amicta* (Smith), *Ptychosyrinx bisinuata* (Martens) and *Turridrupa jubata* (Hinds). The same phenomenon of an enlarged central taking over the space occupied by the laterals in the prototypic radula is also exhibited in the turriculid species *Turricula javana* (Linnaeus), the 'cochlespirid' genera *Cochlespira* and *Aforia*, and also some species of the Clavatulinae. In the last-mentioned the central has a large spreading base, but it is very thin and is revealed only by staining.

Staining has also revealed that many species of *Gemmula* and *Turris* have a thin plate connecting the two basal limbs of the "wishbone". Thiele's (1929) figure of the *Turris babylonia* radula shows this feature.

A variation of the wishbone marginals shows a severing of the distal basal limb, and this would appear to be a provision for the adjustment or inclination of the tooth, in that the hinged limb is embedded in the lingual ribbon.

The prototypic radula has so far proved to be exclusive to the Clavinae, but it is not difficult to visualise the paired marginal radula as a derivation from it.

A purely conjectural explanation of the transition from the prototypic to the truly toxoglossate state of the radula could be interpreted in the following way. The prototypic radula, as it occurs in situ, not spread out on a slide, is tubular, with the marginals erect, parallel to the central, and in that position the marginals extend beyond both the central and the laterals. It would seem then that the marginals administer the toxic fluid whilst the central and laterals serve in mastication. In the species that assume a more actively predaceous feeding method it is not difficult to visualise the transition of the marginals to the bundle of arrows fully toxoglossate state, at the expense of the masticatory teeth.

A puzzling situation arises in the presence of the fully toxoglossate dentition in more than one subfamily group. This type of dentition



occurs in the Clavinae, along with the prototypic and of apparently equal frequency; it also occurs in the Mangeliinae to a limited extent, and also in at least one member of the Clavatulinae.

The Mangeliinae, as at present envisaged, covers several forms of paired marginal types, additional to the barbed-arrow radula. These range from a broad leaf-shaped marginal in *Bela* and *Mangelia* to a hafted dagger type, with a spur on one side.

There is a gradual transition, however, from one to the other, the haft being an insertion plate in the radular ribbon; in some species represented by a thickened muscle, in others by a prolongation of the actual tooth.

Typically, the daphnellid pair of marginal teeth are not barbed but the point is constricted

from each side, resulting in a termination resembling a candle-flame. This style of dentition occurs in the mitromorphid group of genera also but it is not clear whether these are daphnellids, or borsonids by virtue of their pillar plications. In *Daphnella* and some allied genera the base of the pillar often bears obscure oblique plications but never definite plaits.

The muricid-like radula in *Hormospira* and *Pseudomelatoma* seems to be restricted to these West American genera. However, the resemblance of the radula to that of the rachi-glossids (1+1+1) is undoubtedly superficial, resultant largely from the crass nature of the teeth, which are more robust than in most turrids. If the outer teeth are considered to be marginals, which they almost certainly are, and not laterals, then there is no dissimilarity from the toxoglossate formula (1+0+1+0+1).

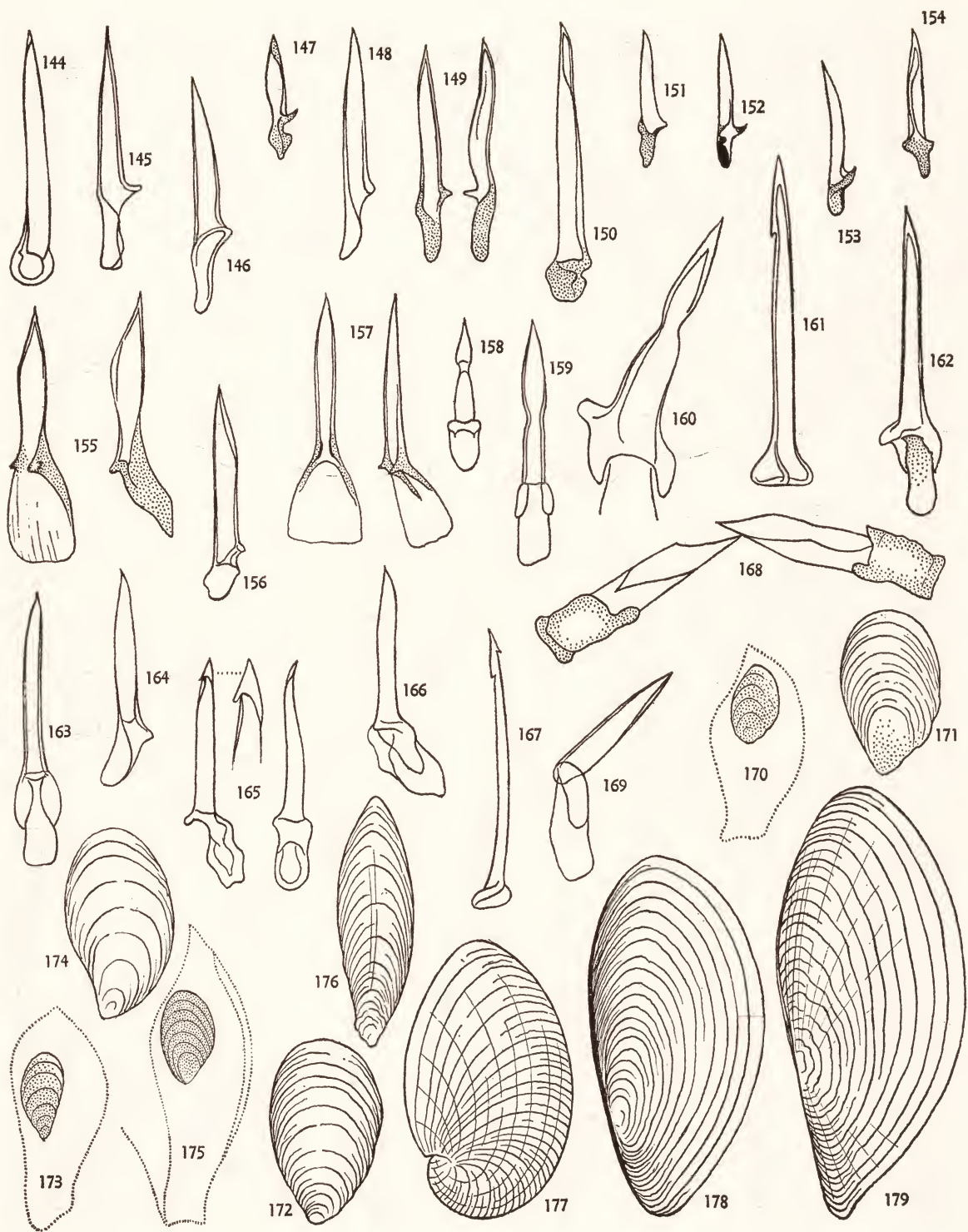














TEXT FIGURE B. Fig. 1—*Turricula catena* (Reeve, 1843), Gulf of Oman (USNM423870). Fig. 2—*Turricula tornata* (Dillwyn, 1817), S.W. India, 10 fathoms (Ponder). Fig. 3—*Turricula tornata fulminata* (Kiener, 1839-40), Mekran coast (USNM-367073). Fig. 4—*Turricula javana* (Linnaeus, 1767), Philippines (Univ. Mus. Copenhagen) (Ponder). Fig. 5—*Turricula nelliae spurius* Hedley, 1922, Sumatra, 25 metres (Univ. Mus. Copenhagen) (Ponder). Fig. 6—*Comitas onokeana vivens* Dell, 1956, New Zealand, Chatham Rise, 260 fathoms (Ponder). Fig. 7—*Comitas saldanhae* (Barnard, 1958), South Africa (Barnard, 1958, p.95, fig.3f.). Fig. 8—*Knefastia dalli* (Bartsch, 1944), Lower California (USNM2931). Fig. 9—*Knefastia funiculata* (Kiener, 1839-40) Gulf of California (USNM55242). Fig. 10—*Megasurcula carpenteriana* (Gabb, 1865), Monterey, 93 fathoms (USNM223587). Fig. 11—*Megasurcula retondi* (Gabb, 1866), California, 100-199 fathoms, La Jolla (USNM209208). Fig. 12—*Leucosyrinx verrilli* (Dall, 1881), 734 fathoms off Guadeloupe (USNM87393). Fig. 13—*Rhodopetoma rhodope* (Dall, 1919), California, 82 fathoms, Santa Rosa Island (USNM). Fig. 14—*Marshallena nierstraszi* (Schepman, 1913), Arafura Sea, 1788 metres (Schepman, 1913, pl.28, f.6c.). Fig. 15—*Marshallena nereis* (Smith, 1906), 802 metres off Pemba, East Africa (J. Murray Exped., Brit. Mus.) (Ponder). Fig. 16—*Iwaoa reticulata* Kuroda, 1953, Japan, 150 fathoms off Tosa (Kuroda, 1953, p.181, fig.9). Fig. 17—*Ancistrosyrinx cedonulli* (Reeve, 1843), Gulf of Panama, 153 fathoms (USNM123102). Fig. 18—*Ancistrosyrinx elegans* (Dall, 1881), Florida, 197 fathoms off Tortugas (USNM421774). Fig. 19—*Cochlespira pulchella* (Schepman, 1913), Banda Sea, 250 metres (Univ. Mus., Copenhagen) (Ponder). Fig. 20—*Cochlespira crispulata* (Martens, 1901), off Dar-es-Salaam, 400 metres (Thiele, 1929, p.359, fig. 435). Fig. 21—*Aforia goodei persimilis* (Dall, 1889) (=Irenosyrinx), 677 fathoms, S.W. coast Chile (USNM96530). Fig. 22—*Aforia magnifica* (Strebel, 1908), Palmer Archipelago, 500 metres (Powell, 1942, text fig.A4). Fig. 23—*Aforia japonica* (Dall) Bartsch, 1945, Japan, 369 fathoms off Honshu (USNM205041). Fig. 24—*Aforia circinata* (Dall, 1873), off Alaska (USNM). Fig. 25—*Aforia okhotskensis* Bartsch, 1945, Okhotsk Sea, 73 fathoms (USNM205042). Fig. 26—*Steiraxis aulaca* (Dall, 1895), off Acapulco, 1879 fathoms (USNM123099). Fig. 27—*Pseudomelatomia penicillata* (Carpenter, 1865), Lower California (USNM268761). Fig. 28—*Pseudomelatomia grippi* (Dall, 1919), San Diego, California (USNM203670). Fig. 29—*Pseudomelatomia torosa* (Carpenter, 1863), Monterey, California (USNM56095). Fig. 30—*Hormospira libya* (Dall, 1919), Lower California, Cape San Lucas, 66 fathoms (USNM96576a). Fig. 31—*Hormospira maculosa* (Sowerby, 1834), La Paz, West Mexico (Powell, 1942, pl.A, fig.8). Fig. 32—*Epidironea nodulosa* Laserson, 1954, 60-100 metres off Cronulla, New South Wales (Ponder). Fig. 33—*Epidironea hedleyi* Iredale, 1931, Port Jackson, New South Wales (V. Maes.). Fig. 34—*Cryptogemma benthina* (Dall, 1908), Gulf of Panama, 1270 fathoms (USNM123089). Fig. 35—*Cryptogemma quentinensis* Dall, 1919, off San Diego, 822 fathoms (USNM214068). Fig. 36—*Carinoturris adrastia* (Dall, 1919), Monterey Bay, 581 fathoms (USNM226154). Fig. 37—*Cryptogemma exulans* (Dall, 1889), Galapagos Islands, 634 fathoms (USNM96499). Fig. 38—*Antimelatomia ahiparana* Powell, 1942, New Zealand, trawled Bay of Plenty (Ponder). Fig. 39—*Cryptogemma calypso* Dall, 1919, off San Diego, 822 fathoms (USNM214067).

TEXT FIGURE C. Fig. 40—*Turris babylonica* (Linnaeus, 1758), East Indies (Thiele, 1929, p.361, fig. 439). Fig. 41—*Turris crista* (Lamarck, 1816), Fiji (Ponder). Fig. 42—*Turris (Annulatouris) amicta* (Smith, 1877), Bombay, India (Ponder). Fig. 43—

*Lophiotoma acuta* (Perry, 1811), Java Sea, 18 metres (Ponder). Fig. 44—*Lophiotoma (Lophioturris) indica* (Röding, 1798), Java Sea (Ponder). Fig. 45—*Xenoturris cingulifera* (Lamarck, 1822), Fiji (Ponder). Fig. 46—*Polystira albicarinata* (Sowerby, 1870), Lower California, 33 fathoms (USNM-195338). Fig. 47—*Polystira albida* (Perry, 1811), off Cuba, 250 fathoms (USNM87383). Fig. 48—*Polystira picta* (Reeve, 1843), Perlas Islands (Ponder). Fig. 49—*Lucerapex angustata* (Powell, 1940), New Zealand, 24 fathoms Whangaroa (Ponder). Fig. 50—*Gemmula hombroni* Hedley, 1922, Sumatra, 29 metres (Univ. Mus., Copenhagen) (Ponder). Fig. 51—*Gemmula congener diomedea* Powell, 1964, Java Sea, 200 metres (Univ. Mus. Copenhagen) (Ponder). Fig. 52—*Comitas subsuturalis* (Martens, 1902), Gulf of Aden, 1270 metres (J. Murray Exped., Brit. Mus.) (Ponder). Fig. 53—*Gemmula gilchristi* Sowerby, 1902, Sunda Strait, 30 metres (Univ. Mus., Copenhagen) (Ponder). Fig. 54—*Gemmula (Unedogemmula) unedo* (Kiener, 1839-40), off west coast of India (Ponder). Fig. 55—*Ptychosyrinx bisinuata* (Martens, 1901), off East Africa, 1134 metres (Martens & Thiele, 1903, pl.1, fig.8). Fig. 56—*Fusiturris undatiruga* (Bivona, 1832), Mediterranean (Thiele, 1929, p.361, fig.441). Fig. 57—*Antiplanes (Rectiplanes) santarosana* (Dall, 1902), off Santa Rosa Island, California (USNM206442). Fig. 58—*Antiplanes (Rectiplanes) thalaea* Dall, 1902, off San Luis Obispo, California (USNM122568). Fig. 59—*Turridrupa jubata* (Hinds, 1843), Philippines (V. Maes.). Fig. 60—*Clavatula caerulea* (Weinkauff, 1875), West Africa (Thiele, 1925, p.204, fig.15). Fig. 61—*Clavatula mystica* (Reeve, 1843) (=sacerdos Reeve, 1845), West Africa (USNM305770). Fig. 62—*Clavatula rubrifasciata* (Reeve, 1845), West Africa (Thiele, 1925, p.204, fig.12). Fig. 63—*Perrona (Tomellana) lineata* (Lamarck, 1816), West Africa (Thiele, 1925, p.204, fig.14). Fig. 64—*Pusionella vulpina* (Born, 1780), West Africa (Thiele, 1925, p.204, fig.17). Fig. 65—*Pusionella nifat* (Bruguère, 1792), West Africa (Thiele, 1925, p.204, fig.16). Fig. 66—*Clionella sinuata sigillata* (Reeve, 1846), South Africa, Saldana Bay (Discovery II) (Ponder). Fig. 67—*Clionella sinuata* (Born, 1778), South Africa (Thiele, 1925, p.204, fig.13). Fig. 68—*Clionella (Toxiclionella) tumida* (Sowerby, 1870), South Africa, False Bay (Univ. Mus., Copenhagen) (Ponder). Fig. 69—*Crassispira nautica* Pilsbry & Lowe, 1932, Gulf of California (USNM264705). Fig. 70—*Crassispira rudis* (Sowerby, 1834), Panama (USNM484895). Fig. 71—*Crassispira incrassata* (Sowerby, 1834), Panama, 3-5 fathoms, Melones (Zool. Mus., Copenhagen) (Ponder). Fig. 72—*Crassispira (Crassispirella) rugitecta* (Dall, 1918), San Bartolomé Bay, Lower California (USNM226911). Fig. 73—*Crassispira arsinoe* Dall, 1919, San Bartolomé Bay, Lower California (USNM56135). Fig. 74—*Crassispira (Burchia) redondoensis* (Burch, 1938), California, 25 fathoms off Redondo Beach (USNM3842). Fig. 75—*Carinapex minutissima* (Garrett, 1873), Hawaii (Ponder).

TEXT FIGURE D. Fig. 76—*Drillia umbilicata* (Gray, 1838), West Africa (Thiele, 1929, p.357, fig. 432). Fig. 77—*Drillia falsa* Barnard, 1958, South Africa (Barnard, 1958, p.95, fig.3a). Fig. 78—*Splendrillia debilis* Finlay, 1927, New Zealand, Whangarei Heads (Ponder). Fig. 79—*Splendrillia aoteana* Finlay, 1930, New Zealand, 16 fathoms, Cape Karekare (Ponder). Fig. 80—*Splendrillia woodsi* (Beddome, 1883), New South Wales, 60-70 fathoms off Cronulla (Ponder). Fig. 81—*Neodrillia cydia* Bartsch, 1943, Florida, 25 fathoms (USNM4111096). Fig. 82—*Agladrillia panamella* (Dall, 1908), Panama Bay, 47 fathoms (USNM122771). Fig. 83—*Spirotropis carinata* (Philippi, 1844), England, 120 fathoms (USNM-189877). Fig. 84—*Clavus canicularis* (Röding, 1798), East Indies (USNM). Fig. 85—*Clavus johnsoni*



(Bartsch, 1934) (= *Eldridgea*), Puerto Rico (USNM-430852). Fig. 86—*Clavus* n.sp., Hawaiian Islands, Hilo (Ponder). Fig. 87—*Kylisx alcmene* (Dall, 1919), Gulf of California, Agua Verde Bay (USNM-268911). Fig. 88—*Cymatosyrinx hemphilli* (Stearns, 1871), Lower California, San Bartolomé Bay (USNM268762). Fig. 89—*Imaclava pambertoni* (Lowe, 1935), Gulf of California (USNM). Fig. 90—*Cerodrillia thea* (Dall, 1883), Florida, Clearwater Bay (USNM). Fig. 91—*Elaeocyma empyrosia* (Dall, 1899), California, Point Firmin (USNM192085). Fig. 92—*Elaeocyma halocydne* Dall, 1919, California, off San Pedro (USNM568274). Fig. 93—*Tylotiella humilis* (Smith, 1879), Japan (Habe, 1958, pl.3, fig. 6). Fig. 94—*Tylotiella subobliquata* (Smith, 1879), Japan (Habe, 1958, pl.3, fig.7). Fig. 95—*Tomopleura pouloensis* (Jousseume, 1883), Persian Gulf (Powell). Fig. 96—*Tomopleura* (*Maoritomella*) *carota* (Laseron, 1954), 24-30 fathoms, South Queensland (Ponder). Fig. 97—*Tomopleura* (*Maoritomella*) *albula* (Hutton, 1873), New Zealand, Omaha Bay, 9 fathoms (Ponder). Fig. 98—*Suavodrillia willetti* Dall, 1919, Alaska, Forrester Island (USNM216409). Fig. 99—*Suavodrillia kennicottii* (Dall, 1871), Alaska, Unga Island, 6 fathoms (USNM206201). Fig. 100—*Crassispira* cf. *aesopus* (Schepman, 1913), Banda Sea, 352 metres (Univ. Mus., Copenhagen) (Ponder). Fig. 101—*Carinodrillia haliplexa* Dall, 1919, Gulf of California, Mulage (USNM265991). Fig. 102—*Aoteadrillia rawitensis* (Hedley, 1922), New Zealand, Whangarei Heads (Ponder). Fig. 103—*Crassispira tasconium* (Melvill & Standen, 1901), Gulf of Aden, 220 fathoms (J. Murray exped., Brit. Mus.) (Ponder). Fig. 104—*Inquisitor* cf. *crenularis* (Lamarck, 1816), Japan (Zool. Mus., Copenhagen) (Ponder). Fig. 105—*Inquisitor griffithii* (Reeve, 1843), Iran (Thorson, 1940, p.209, fig.22H). Fig. 106—*Microdrillia optima* (Thiele, 1925), Zanzibar, 463 metres (Thiele, 1929, p.363, fig.446). Fig. 107—*Phenatoma rosea* (Quoy & Gaimard, 1833) (= *novae-zelandiae* Reeve, 1843), New Zealand (Thiele, 1929, p.364, fig.448).

TEXT FIGURE E. Fig. 108—*Crassispira sinensis* (Hinds, 1843), Java Sea, 30 metres (Univ. Mus., Copenhagen) (Ponder). Fig. 109—*Inodrillia ino* Bartsch, 1943, Florida 135 fathoms (USNM318184). Fig. 110—*Inodrillia nucleata* (Dall, 1881), Florida, 229 fathoms (USNM318184). Fig. 111—*Inodrillia miamia* Bartsch, 1943, Florida, 58 fathoms (USNM-411463). Fig. 112—*Haedropleura septangulalis* (Montagu, 1803), Europe (Thiele, 1929, p.362, fig. 443). Fig. 113—*Borsonia ochracea* Thiele, 1925, off Somali Coast, 1644 metres (Thiele, 1929, p.365, fig. 449). Fig. 114—*Borsonella barbarensis* Dall, 1919, California, 302-614 fathoms off Santa Barbara (USNM86841). Fig. 115—*Borsonella coronadoi* (Dall, 1908), California, 34 fathoms off Coronados Islands (USNM210305). Fig. 116—*Borsonella calli-cesta* (Dall, 1902), West Mexico, 660 fathoms off Acapulco (USNM109036). Fig. 117—*Borsonella nicoli* Dall, 1919, California, 158 fathoms off Nicolas Islands (USNM198925). Fig. 118—*Scrinium neozelandica* (Suter, 1908), New Zealand, Whangarei Heads (Ponder). Fig. 119—*Bathytoma* (*Micantapex*) *finlayi* Powell, 1940, New Zealand, off Cape Colville (Dell, 1956, pl.24, fig.258). Fig. 120—*Bathytoma* (*Parabathytoma*) *luhdorfi* (Lischke, 1872), Japan, Sagami (Ponder). Fig. 121—*Bathytoma* (*Riuguhdrillia*) *parengonia* (Dell, 1956), New Zealand, Chat-ham Rise, 260 fathoms (Dell, 1956, pl.24, fig.257). Fig. 122—*Lovellona atramentosa* (Reeve, 1849), Zanzibar (V. Orr, 1959, p.77, fig.1). Fig. 123—*Mitromorpha carpenteri* Glibert, 1954 (= *filosa* Carpenter, 1865), California (V. Orr, 1959, p.77, fig.2). Fig. 124—*Mitromorpha* n.sp. Hawaiian Island, Oahu (Ponder). Fig. 125—*Benthofascis biconica* (Hedley, 1903), New South Wales, off Cronulla, 75 metres (Ponder). Fig. 126—*Genota mitriformis* (Wood,

1828), West Africa Thiele, 1929, p.372, fig.458). Fig. 127—*Bela nebula* (Montagu, 1803), England, Exmouth (USNM190861). Fig. 128—*Benthomangelia trophonoidea* (Schepman, 1913), Flores Sea, 794 metres (Thiele, 1929, p.367, fig.453). Fig. 129—*Mangelia attenuata* (Montagu, 1803), Norway (Sars, 1878, pl.8). Fig. 130—*Agathotoma penelope* Dall, 1919, Lower California, Agua Verde Bay (USNM-266346). Fig. 131—*Mangelia newcombei* Dall, 1919, Vancouver Island (USNM150965). Fig. 132—*Neoguraleus sinclairi* (Gillies, 1882), New Zealand, Leigh (Ponder). Fig. 133—*Neoguraleus whangaroensis* Powell, 1942, Great Barrier Island, Port Fitzroy (Ponder). Fig. 134—*Neoguraleus interruptus* Powell, 1942, New Zealand, Whangarei Heads (Ponder). Fig. 135—*Neoguraleus murchisoni* (Finlay, 1924), New Zealand, Devonport (Powell, 1942, p.37, fig.16). Fig. 136—*Neoguraleus amoenus* (Smith, 1884), New Zealand, off Cabbage Bay (Ponder). Fig. 137—*Liracraea odhneri* Powell, 1942, New Zealand, 24 fathoms, Cape Karekare (Ponder). Fig. 138—*Antiguraleus murrheus* (Webster, 1906), New Zealand 24 fathoms off Whangaroa (Ponder). Fig. 139—*Cytha-relia amatula* Dall, 1919, California, San Diego (USNM127534a). Fig. 140—*Lienardia mighelsi* Iredale & Tomlin, 1917, Hawaiian Islands (Ponder). Fig. 141—*Glyphostoma gabbi* Dall, 1889, St. Lucia, 116 fathoms (USNM87408). Fig. 142—*Glyphostoma immaculata* Dall, 1908, Gulf of California, 153 fathoms (USNM123115). Fig. 143—*Crockerella crystallina* (Gabb, 1865) (= *lowei* Dall, 1903), California, 50 fathoms off Catalina Island (USNM-109302).

TEXT FIGURE F. Fig. 144—*Nannodiella nana* Dall, 1919, Gulf of California 26 fathoms (USNM-211485). Fig. 145—*Kurtzia arteaga* (Dall & Bartsch, 1910), Vancouver Island (USNM211605). Fig. 146—*Kurtzia cyrene* (Dall, 1919), Lower California, 10 fathoms (USNM331706). Fig. 147—*Kurtziella cerinella* (Dall, 1889), Florida, Clearwater (USNM). Fig. 148—*Kurtziella danae* (Dall, 1919), Gulf of California, Agua Verde Bay (USNM266350). Fig. 149—*Oenopota pyramidalis* (Ström, 1788), Norway (Sars, 1878, pl.8, fig.2). Fig. 150—*Oenopota harpa* (Dall, 1885), Alaska (USNM223402). Fig. 151—*Oenopota alaskensis* (Dall, 1871), Alaska, Unga Island (USNM220912). Fig. 152—*Oenopota pleurotomaria* (Couthouy, 1838), Massachusetts (USNM-173282). Fig. 153—*Oenopota* (*Funitoma*) *albrechti* (Krauss, 1886), Bering Strait (USNM224023). Fig. 154—*Obesotoma lawrenciana* (Dall, 1919), Arctic Ocean (USNM224025). Fig. 155—*Philbertia leufroyi* (Michaud, 1828), Norway (Sars, 1878, pl.8, fig.2). Fig. 156—*Philbertia cordieri* "cancellata Sowerby", Mediterranean (USNM131375). Fig. 157 *Thesbia nana* (Loven, 1846), Norway (Sars, 1878, pl.8). Fig. 158—*Daphnella retifera* Dall, 1889, Florida, 55 fathoms Key West (USNM318710). Fig. 159—*Daphnella bartschi* Dall, 1919, Lower California (USNM267341). Fig. 160—*Daphnella cancellata* Hutton, 1878, New Zealand (Thiele, 1929, p.371, fig.456). Fig. 161—*Typhlodaphne purissima* (Strebel, 1908), South Georgia, 160 metres (Powell, 1951, p.195, fig.92). Fig. 162—*Pleurotomella agassizi* Ver-rill & Smith, 1880, New England, 65-252 fathoms (Ponder). Fig. 163—*Phymorhynchus argeta* (Dall, 1889), off Galapagos, 812 fathoms (USNM96552). Fig. 164—*Phymorhynchus castanea* (Dall, 1895), Galapagos, 1322 fathoms (USNM123134). Fig. 165—*Pontiothauma mirabile* Smith, 1895, South India, 1250 fathoms (Pace, 1903, pl.42, figs.5-7). Fig. 166—*Pontiothauma abyssicola* Smith, 1895, India, 753 fathoms Bay of Bengal (Pace, 1903, pl.42, fig.14). Fig. 167—*Pontiothauma ergata* Hedley, 1916, Antarctica, Enderby Land 300 metres (Powell, 1958, p.205, fig. C3). Fig. 168—*Spergo glandiniformis* Dall, 1895, near Hawaiian Islands 298-375 fathoms (Dall, 1895, pl.24, fig.1). Fig. 169—*Thatcheria mirabilis* Angas,



1877, Japan, Tosa 100-150 fathoms (Kuroda & Habe, 1954, p.82, fig.2).

OPERCULA. Fig. 170—*Neoguraleus whangaroensis* Powell, 1942. Fig. 171 — *N. tenebrosus* (Powell, 1926). Fig. 172—*N. interruptus* Powell, 1942. Fig. 173—*Liracraea odhneri* Powell, 1942. Fig. 174—*Carinapex minutissima* (Garrett, 1873). Fig. 175—*Typhlodaphne purissima* (Strebel, 1908). Fig. 176—*Benthofascis biconica* (Hedley, 1903). Fig. 177—*Marshallena nereis* (Smith, 1906). Fig. 178—*Clio-nella* (*Toxiclionella*) *tumida* (Sowerby, 1870). Fig. 179—*Turricula tornata* (Dillwyn, 1817).

**GEOGRAPHICAL DISTRIBUTION, PAST AND PRESENT**—Of the nine subfamilies of the Turridae, eight of them were already well represented in the Eocene; three, the Turrinae, Borsoniinae and Clavinae extend back to the Paleocene, and two, the Turriculinae and the Conorbiinae, to the upper Cretaceous. The Thatcheriinae, however, is unknown from earlier than the Oligocene.

All the subfamilies are wide ranging geographically, but their relative strengths and distributional patterns have changed from era to era.

At present the most successful subfamilies are Turrinae, Clavinae, Mangeliinae and Daphnellinae. The Conorbiinae have dwindled to a small Recent representation, and both the Clavatulinae and the Borsoniinae appear to be on the wane also, except for the mitromorphid genera, which, however, are doubtful inclusions in the latter subfamily. The Turriculinae, which is evidently the earliest developed of the subfamilies, has maintained a strong representation right through to Recent times. The Turrinae, which were abundant throughout the Tertiary in both Europe and America have shifted their dominance to the Indo-Asiatic scene, and the Mangeliinae, which were sparsely represented in the early Tertiary of Europe, also now exhibit an explosive development in the Indo-Pacific.

The Turriculinae are found in most seas, particularly those adjacent to the continental margins, and in the deep ocean basins. Their world-wide distribution is resultant from the antiquity of the subfamily, which goes back to at least the upper Cretaceous.

Typical *Turricula* is of Indo-Asiatic range, mostly in warm shallow waters, but the closely allied *Comitas* inhabits the deeper and cooler waters over the equatorial zone, as well as the temperate zones of both the Indian and Pacific Oceans. Regional genera have developed in comparatively recent times, notably *Bathybela* and *Belomitra* in the deep waters of the South Atlantic; *Paradrillia*, *Makiyamaia* and *Nihonia* in the Indo-Asiatic area; and *Megasurcula*, *Knefastia*, *Hormospira* and *Pseudomelatoma* in California and tropical West America.

Even in the Cretaceous and early Tertiary there was considerable diversity and localisa-

tion of turriculid genera, as instanced by *Amuletum*, *Beretra*, *Remnita* and *Fusimilis*, from the Cretaceous of the south-eastern United States, *Belophos*, *Belatomina* and *Liratomina* from the Oligocene to Pliocene of Southern Australia, and *Zemacies*, *Insolentia*, *Tholitoma* and *Austrotoma* from the Paleocene to Pliocene of New Zealand. On the other hand some lower Tertiary turriculid genera were wide ranging, i.e., *Apiotoma*, *Cochlespira* and *Pleurofusua*.

In the European, American and New Zealand lower Tertiary there are many turritid genera, each characterised by a gemmate peripheral keel, i.e., *Eopleurotoma*, *Oxyacrum*, *Epaxsis* and *Gemmula* from the Paleocene of Europe, *Eopleurotoma*, *Coronia*, *Hesperiturris* and *Gemmula* from the Eocene of the United States, and *Eoturris*, *Campylacrum* and *Gemmula* from the Paleocene and Eocene of New Zealand. Of this group of apparently closely related genera only *Gemmula* has reached modern times, and its greatest development is now in the warm waters of the Indo-Pacific. The genus seems to have disappeared entirely from European seas, and is represented in American waters by but a few species.

Recent derivatives from *Gemmula*, in the Indo-Pacific, are *Unedogemmula* and *Pinguigemmula* (Miocene to Recent), *Ptychosyrinx* (Pliocene to Recent), but extending to the North Atlantic as well, and *Cryptogemma*, Recent only, in deep water from Panama to Ecuador.

Also in the Turrinae, the genus *Fusiturris* was abundantly represented in the European Tertiary from the Paleocene to the Pliocene, but it is now restricted to the Mediterranean and West Africa.

The Indo-Pacific counterparts of *Fusiturris* are the genera *Lophiotoma*, *Lucerapex* and *Turris*, the first and last-mentioned with a geological range of Miocene to Recent, and the second one, Pleistocene and Recent in deep water. The genera *Pleuroliria* and *Polystira* represent typical Turrinae in eastern and western tropical America, the former with a time range of Eocene to Oligocene and the latter Miocene to Recent. Deep-water northern cold-water derivatives of the typical Turrinae are the sinistral *Antiplanes* and its dextral counterpart, *Rectiplanes*, the former, Oligocene of North Germany, Pleistocene and Recent from California to Japan, and the latter, Pliocene to Recent from California to Japan. The genus *Xenuroturris* is a Recent derivation from *Lophiotoma*, and its geographical range is restricted to the Indo-Pacific.

The Clavatulinae now have a restricted range, confined to the Mediterranean, and down the west coast of Africa to South Africa. In the Tertiary, however, the subfamily was abundantly represented in European formations



from the Paleocene to the Pliocene, as well as in the Eocene of Morocco, Pakistan, Burma and Sumatra.

The Clavinae, many of which have the prototypic style of radula, occur in all warm seas, notably in the Indo-Pacific, West and South Africa, the Caribbean and tropical West America. However, there are temperate and even colder water occurrences, in *Splendrillia*, which extends throughout New Zealand, and *Spirotropis*, which ranges in deep water from northern Europe to Subantarctic and Antarctic seas. Such a wide dispersal, coupled with the primitive type of radula, suggest considerable antiquity for the subfamily, but only *Spirotropis* is known definitely to extend back to as far as the Miocene. However, if *Cymatosyrinx* is correctly assigned to the "prototypic" group of genera, then its range goes back to the Eocene. However there is no reliable means of distinguishing upon shell characters alone, the claviniids with the prototypic radula from those of presumed more recent development, that have the fully developed toxoglossate radula of marginals only. Only by comparison with Recent shells of known radula type, can the relevant fossils be correlated. Shells of general claviniid facies extend back to the Paleocene of Europe, and are of world-wide Recent distribution.

In the atolls, reefs and small isolated island groups of the Indo-Pacific, large turrids are either absent or but poorly represented, *Lophiotoma acuta*, almost the only exception, the faunules being composed mainly of small mangelinids and daphnellids. The most characteristic mangelinid genera of the islands of the Indo-Pacific are *Eucithara*, *Lienardia*, *Etrema* and *Macteola*. Typical *Daphnella* is abundantly represented over the entire Indo-Pacific, and occurs in tropical American waters as well, its distribution being the result of an efficient free-swimming larva, reflected in its 'sinusigerid' protoconch.

Some genera have a cold-water preference, and one of these, *Pleurotomella*, inhabits the deep ocean basins of most seas. The genus *Leucosyrinx* is similarly widespread in deep water. Still another deep-water genus, *Pontiothauma*, has a range extending from Antarctica to the equatorial Indian Ocean, following the northward flowing deep cold waters from the Southern Ocean, and a closely allied genus, *Spergo*, has a North Pacific range in the deep basins, extending from Hawaii to Japan.

The genus *Aforia* achieves "bipolarity" by going deep over the tropical American west coast, in an extensive range from Japan, across

the Aleutian Chain to North-West America, southward down the entire American west coast, along the Scotia Arc to Antarctica and the Argentine Basin, then across the Southern Ocean to Kerguelen and Heard Islands. The depths concerned with this vast distribution vary from between 60 and 1500 fathoms, but the respective associated bottom temperatures are remarkably constant, the extreme variation being not more than ten degrees. The highest associated bottom temperature was 41.8° F., and the lowest 30.9° F. Undoubtedly the upwelling of cold waters, such as The Peruvian Coastal Current, has enabled *Aforia* to achieve its uninterrupted by-passing of the tropics.

Still other examples of stenothermic cold-water genera that go deep under tropical waters are *Marshallena* and *Cryptodaphne*, both formerly considered to be restricted to the lower Tertiary of New Zealand, but now recognised from the deep waters of the Indo-Pacific, ranging from the Gulf of Aden to Japan.

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## SYSTEMATIC

LIST OF RECOGNIZED GENERA AND SUB-  
GENERA OF THE TOXOGLOSSATE FAMILIES  
SPEIGHTIIDAE AND TURRIDAE

## Family SPEIGHTIIDAE Powell, 1942

- \*ANDICULA Olsson, 1929. L. Eocene, Peru.  
 \*CLINUROPSIS Vincent, 1913. Paleoc. Belg. & Congo; Eoc. Egypt.  
 \*SPEIGHTIA Finlay, 1926. M. Eocene, New Zealand.

## Family TURRIDAE Swainson, 1840 (emended)

- (=PLEUROTOMINAE Swainson, 1840=TURRITIDAE H. & A. Adams, 1853=PLEUROTOMIDAE Chenu, 1859=TURRIDAE Hedley, 1922)

## Subfamily TURRICULINAE Powell, 1942

(=Cochlespirinae Powell, 1942)

- (a) typical: operculum clavatulid—  
 TURRICULA Schumacher, 1817 (=Surcula H. & A. Adams, 1853). Rec. Indo-Pacific & trop. W. Amer. Paleoc. — Plioc., Eur. U.S. Amer. & S.E. Asia.

- PARADRILLIA Makiyama, 1940 (=Alticlavatula Mac Neil, 1960). Rec. Indian O. — Jap. & N.E. Austr. Plioc. — Mioc. Jap. & S.E. Asia.  
 MAKIYAMAIA Mac Neil, 1960. Rec. Jap. & S.E. Asia. Eoc. — Plioc. Jap.

- (b) operculum with a subterminal nucleus—  
 MARSHALLENA Allan, 1927 (=Sugitania Kuroda, 1958=Sugitanitoma Kuroda, 1959). Eoc. — Plioc. N.Z. Rec. Aden-Japan.

- \*MARSHALLARIA Finlay & Marwick, 1937 Paleoc. — Olig. N.Z.

- \*NOTOGENOTA Powell, 1942. Eoc. New Zealand.

- (c) operculum with a terminal nucleus—  
 IWAOA Kuroda, 1953. Rec. Japan.

- COMITAS Finlay, 1926 (=Carinacomitas Powell, 1942). Rec. S. Afr. — Jap., Austr. & N.Z. Olig. — Plioc. N.Z., S.E. Asia & Japan

- ANTICOMITAS Powell, 1942 Rec. New Zealand.  
 PARACOMITAS Powell, 1942. Plioc. — Rec. N.Z. & Okinawa.

- ANTIMELATOMA Powell, 1942. Rec. & Pleist., N.Z.

- NIHONIA Mac Neil, 1960 (=Fusosurcula Taki, 1951). Rec. E. Afr. — Japan. Olig. — Plioc., S.E. Asia.

- LEUCOSYRINX Dall, 1889. Rec. S.E. United States, Caribb., S. Atlant., Antarctica, E. Pac. N. Aust. & N.Z. Mioc. — Plioc. Okinawa.

- VEXITOMINA Powell, 1942. Rec. Mauritius — Philippines, S. Aust. & N.Z.

- KNEFASTIA Dall, 1919. Rec. L. Calif. — Ecuador. Mioc. — Olig. Washington — Peru, Florida & Dominican Rep.

- FUSITURRICULA Woodring, 1928. Rec. trop. W. Amer. Mioc. Caribbean.

- \*subgen. CRENATURRICULA Vokes, 1939. Paleoc. — Eoc. Calif. & Eur.

- subgen. FUSISYRINX Bartsch, 1934. Rec. Puerto Rico.

- CRUZITURRICULA Marks, 1951. Rec. trop. W. Amer. Eoc. — Plioc. Costa Rica — Peru.

- MEGASURCULA Casey, 1904. Rec. Calif. Plioc. — Mioc. Calif., Jap., Ecuador.

- RHODOPETOMA Bartsch, 1944. Rec. California. (d) muricid-like radula—

- HORMOSPIRA Berry, 1958. Rec. L. Calif. — Ecuador.

- TIARITURRIS Berry, 1958. Rec. trop. W. America.

- PSEUDOMELATOMA Dall, 1918. Olig. — Rec., Calif., & L. Calif.

- subgen. LAEVITECTUM Dall, 1919. Rec. G. of Calif.

- (e) other Recent genera—

- AUSTROCARINA Laseyron, 1954. Rec. S.E. Aust.

- BATHYBELA Kobelt, 1905. Rec. Azores—Morocco.

- BELATURRICULA Powell, 1951. Rec. S. Georgia, S. Afr. & Phil. Ids.

- BELOMITRA Fischer, 1882 (=Pleurobela Locard, 1897). Rec. Port. — Azores.

- CLAVOSURCULA Schepman, 1913. Rec. Flores Sea.

- ?TYPHLOSIRINX Thiele, 1925. Rec. Aden — Indonesia.

- (f) Cretaceous-Tertiary genera—

- \*AMULETUM Stephenson, 1941. Cret., S.E. United States.

- \*subgen. LUTEMA Stephenson, 1941. Cret. S.E. United States.

- \*BERETRA Stephenson, 1941. Cret. S.E. United States.

- \*REMUNITA Stephenson, 1941. Cret. S.E. United States.

- \*FUSIMILIS Stephenson, 1941. Cret. S.E. United States & W. Afr.

- \*SCALATURRIS Brebion, 1954. Cret. W. Africa.

- APIOTOMA, Cossmann, 1889. Rec. E. Indies. Eoc. — Mioc., France, India, Java & S.E. Austr.

- \*ZEMACIES Finlay, 1926. Paleoc. — Plioc., New Zealand.

- \*INSOLENTIA Finlay, 1926. Eoc. — Mioc. N.Z. & Tasmania.

- \*THOLITOMA Finlay & Marwick, 1937. Paleoc. New Zealand.

- \*CATENOTOMA Cossmann & Pissarro, 1900. Eoc. France.

- \*STENODRILLIA Korobkov, 1955. Plioc., Italy.

- \*ACAMPTOGENOTIA Rovereto, 1899 (=Pseudotoma Bellardi, 1875 = Pseudotomina Finlay, 1924). Eoc. — Plioc. Eur., U.S. Amer. & Mex.

- \*AUSTROTOMA Finlay, 1924. Paleoc. — Plioc. N.Z., Tasmania & Victoria.

- \*BELOPHOS Cossmann, 1901. Olig., S.E. Australia.

- \*BELATOMINA Powell, 1942. Olig. — Mioc. S.E. Australia.

- \*LIRATOMINA Powell, 1942. Olig. — Plioc., S.E. Australia.

- \*STRUTHIOLARIOPSIS Wilckens, 1904. Cret. Chile.

- \*PLEUROFUSIA Gregorio, 1890 (=Tropisurcula Casey, 1904 = Tropidosurcula Cossmann, 1906). Eoc. — Mioc., United States, Mex., India, Pakistan & Burma.

- \*ORTHOSURCULA Casey, 1904. Eoc. — Olig., S. United States.

- \*HEMISURCULA Casey, 1904. Paleoc. — Eoc., S. United States & Mex.

- \*SULLIVANIA Harris & Palmer, 1947. Eoc. S.E. United States.

- \*EOSURCULA Casey, 1904. Eoc., S.E. United States & Mexico.

- \*LEPTOSURCULA Casey, 1904. Eoc., Texas.

- \*COCHLESPIRELLA Casey, 1903. Eoc. S.E. United States.

- \*SURCULOMA Casey, 1904 (=Volutapex Harris, 1937). Eoc., S.E. United St.

- \*LYROSURCULA Casey, 1904. Eoc., S.E. United States.

- \*MICROSURCULA Casey, 1904. Eoc., S.E. United States.

\* Denotes an exclusively fossil occurrence.



- ANCISTROSYRINX Dall, 1881 (= *Candelabrum* Dall, 1878). Eoc. — Rec., S.E. United States, Caribb. & trop. W. America.
- COCHLESPIRA Conrad, 1865 (= *Coronasyrinx* Powell, 1944 = *Rouaultia* Bellardi, 1878). Rec. India — Jap. Eoc. — Mioc., Eur. U.S. Amer., Okinawa & Austr.
- \*COCHLESPIROPSIS Casey, 1904. Eoc. U.S. Amer.
- \*TAHUSYRINX Powell, 1942. Eoc., New Zealand.
- \*PARASYRINX Finlay, 1924. Olig., New Zealand.
- \*subgen. LIRASYRINX Powell, 1942. Olig., New Zealand.
- \*COSMASYRINX Marwick, 1931. Olig. — Mioc., New Zealand.
- AFORIA Dall, 1889 (= *Irenosyrinx* Dall, 1908). Rec. Bering Sea, W. Amer., South. O., Antarctica. Olig. — Plioc., Jap. Washington.
- STEIRAXIS Dall, 1895. Rec. Eastern Pacific.

#### Subfamily TURRINAE Powell, 1942

- \*EOPLEUROTOMA Cossmann, 1889 (= *Eodrillia* Casey, 1904). Paleoc. — Eoc., Eur., U.S. Amer., Peru.
- \*Subgen. OXYACRUM Cossmann, 1889. Eocene Europe.
- \*EOTURRIS Finlay & Marwick, 1937. Eoc. — Olig., New Zealand.
- \*CAMPYLACRUM Finlay & Marwick, 1937. Paleoc., New Zealand.
- \*EPALXIS Cossmann, 1889. Eocene, Europe.
- \*CORONIA Gregorio, 1890. Eoc., U.S. Amer. & Mexico.
- \*subgen. INFRACORONIA Harris & Palmer, 1947. Eoc., U.S. Amer.
- \*HESPERITURRIS Gardner, 1945. Eoc., U.S. Amer. & Mexico.
- \*TRYPANOTOMA Cossmann, 1896. Eoc. U.S. Amer.
- \*TRYPANOTOPSIS Gardner, 1945. Eoc. U.S. Amer.
- \*SINISTRELLA Meyer, 1887. Eoc. U.S. America.
- \*HEMIPLEUROTOMA Cossmann, 1889. Miocene, Europe.
- GEMMULA Weinkauff, 1875 (= *Eugemmula* Iredale, 1931). Eoc. — Rec.; most warm seas.
- subgen. UNEDOGEMMULA Mac Neil, 1960. Mioc. — Rec., Indian O. & E. Austr.
- PINGUIGEMMULA Mac Neil, 1960. Mioc — Rec., S.E. Asia.
- PTYCHOSYRINX Thiele, 1925 (= *Bathybermudia* Haas, 1949). Plioc. — Rec., Indian O. & Bermuda.
- \*subgen. KUROSHIOTURRIS Shuto, 1961. Mioc. — Plioc., Jap. & Okinawa.
- CRYPTOGEMMA Dall, 1918. Rec., tropical W. America.
- CARINOTURRIS Bartsch, 1944. Recent, California.
- EPIDIRELLA Iredale, 1931 (= *Austrogemmula* Laseron, 1954). Plioc — Rec., S.E. Australia.
- FUSITURRIS Thiele, 1929 (= *Tyrrhenoturris* Coen, 1929). Paleoc. — Plioc., Eur., Rec., Medit. & W. Africa.
- LUCERAPEX Iredale, 1936. Mioc. — Rec., Indian O., S.E. Australia & New Zealand.
- LOPHIOTOMA Casey, 1904. Mioc. — Rec., Indo-Pacific.
- subgen. LOPHIOTURRIS Powell, 1964. Mioc. — Rec., Indo-Pacific.
- NEW GENUS Powell (ms.). Rec., S.E. Asia.
- \*OPTOTURRIS Powell, 1944. Olig. — Plioc., Austr. & Japan.
- TURRIS Röding, 1798 (= *Pleurotoma* Lamarck, 1799 = *Pleurotomus* Montfort, 1810). Mioc. — Rec., Indo-Pacific.
- \*PLEUROLIRIA Gregorio, 1890. Eoc. — Olig., U.S. America.
- \*subgen. JOSEPHINA Gardner, 1945. Mioc., Florida & Mexico.

- POLYSTIRA Woodring, 1928 (= *Oxytropia* Glibert, 1955). Mioc. — Rec., Fla., W. Indies, Panama & W. Mexico.

- ANTIPLANES Dall, 1902. Olig. — Rec., N. Pacific & N. Europe.
- subgen. RECTIPLANES Bartsch, 1944 (= *Rectisulcus* Habe, 1958). Plioc. — Rec., Calif., Alaska & Japan.

- \*ECHINOTURRIS Powell, 1942. Olig. — Mioc., New Zealand.
- \*VERUTURRIS Powell, 1944. Olig — Plioc., Australia.
- \*subgen. CINGULITURRIS Powell, 1964. Mioc., Australia.
- XENUROTURRIS Iredale, 1929 (= *Clamturris* Iredale, 1931). Rec. Indo-Pac.
- VIRIDOTURRIS Powell, 1964. Rec., S.E. Australia.

- EPIDIRONA Iredale, 1931 (= *Epideira* auct.). Rec. Persian G. to China seas & S.E. Aust., Mioc. — Plioc. Aust.
- TURRIDRUPA Hedley, 1922. Rec. Indo-Pacific & Mioc. N.Z.
- AUSTROTURRIS Laseron, 1954. Rec. Australia.

- TARANIS Jeffreys, 1870 (= *Fenestrosyrinx* Finlay, 1926 = *Allo* (Jousseume) Lamy, 1934 = *Feliciella* Lamy, 1934). Plioc. — Rec., cosmopolitan.
- MICROPLEUROTOMA Thiele, 1929. Rec. S. Africa. ?Olig., Japan.

#### Subfamily CLAVATULINAE, H. & A. Adams, 1858

- CLAVATULA Lamarck, 1801. Rec. W. Africa. Olig. — Plioc., Europe.
- PERRONA Schumacher, 1817. Rec. N. to W. Africa. Mioc., Europe.
- subgen. TOMELLANA Wenz, 1943 (= *Tomella* Swainson, 1840). Rec. W. Afr..
- CLIONELLA Gray, 1847. Rec. S. & S.W. Africa.
- subgen. TOXICLIONELLA Powell (nov.), Rec. S. Africa.
- PUSIONELLA Gray, 1847 (= *Netrum* Philippi, 1850). Rec. N. to W. Africa. Mioc. Europe.
- \*TRACHELOCHETUS Cossmann, 1889. Eocene, Europe.
- \*PYRENOTURRIS Eames, 1952. Eocene, Pakistan.

#### Subfamily BORSONIINAE Bellardi, 1875

- BORSONIA Bellardi, 1839. Rec. Indian O., S. Aust., Caribb. & S. Atlantic. Paleocene — Plioc., Eur., Indonesia, Aust., Jap. & Mexico.
- \*subgen. BOETTGERIOLA Wenz, 1943 (= *Boettgeria* Peyrot, 1932). Mioc., France.
- CORDIERIA Rouault, 1848 (= *Phlyctaenia* Cossmann, 1889 = *Phlyctis* Harris & Burrows, 1891 = ?*Lictoconcha* Gregorio 1880). Rec. Caribb. Paleoc. — Plioc., Eur., S.E. United States, Calif. & N.Z.
- \*PLEUROPYRAMIS Vredenburg, 1921. Miocene, Burma.
- BORSONELLA Dall, 1908. Rec. Calif. — Panama. Mioc. — Pleist. Calif., Panama, Dominican Rep., Okinawa & N.Z.
- DIPTYCHOPHILA Berry, 1964. Recent, Panama.
- \*SCOBINELLA Conrad, 1848 (= *Zelia* Gregorio, 1890). Eoc. — Olig., S. United States, Caribb., Mex., Panama & Peru.
- \*MONILIOPSIS Conrad, 1865. Eoc., S. United States & Peru.
- \*DOMENGINELLA Vokes, 1939. Eocene, Calif.
- \*PLENTARIA Harris, 1937. Eocene, S. Utd. States.
- \*PROTOSURCULA Casey, 1904. Eoc., S. United States & Mexico.

- \*VAUGHANITES Woodring, 1928. Miocene, Jamaica.
- \*EOSCOBINELLA Powell, 1942. Eocene, New Zealand.
- \*MITRATOMA Olsson, 1930. Eocene, Peru.
- \*EUCHEILODON Gabb, 1860. Eoc. S. United States & Mexico.
- \*BURIDRILLIA Olsson, 1942. Plioc., Panama & Costa Rica.
- DARBYA Bartsch, 1934. Recent, Puerto Rico.
- BATHYTOMA Harris & Burrows, 1891 (= *Dolichotoma* Bellardi, 1875). Rec. Caribb. & Indo-Pacific. Eoc. — Plioc., Eur., S. United States, India, E. Indies & N.Z.
- subgen. PARABATHYTOMA Shuto, 1961. Mioc. — Rec., Japan.
- subgen. RIUGUHRILLIA Oyama, 1951. Rec. Jap. & N.Z.
- subgen. MICANTAPEX Iredale, 1936. Rec. S.E. Aust. & N.Z. Olig. — Pleist. Jap., Aust. & N.Z.
- \*PARABORSONIA Pilsbry, 1922. Mioc., Dominican Rep., Costa Rica, Trinidad & Java.
- \*GLYPTOTOMA Casey, 1904. Eoc. S. United States & Olig. Mexico.
- \*APHANITOMA Bellardi, 1875. Mioc. — Plioc., Europe.
- \*ASTHENOTOMA Harris & Burrows, 1891 (= *Oligotoma* Bellardi, 1875). Eoc. — Mioc., Eur., S.E. Amer., Java & Ceram.
- \*ENDIATOMA Cossmann, 1896. Eocene, France.
- ?\*NICOLEA Gregorio, 1880. Eocene, Europe.
- \*CRYPTOBORSONIA Powell, 1944. Olig. — Mioc., Victoria, Aust.
- (mitromorphoid genera)
- MITROMORPHA Carpenter, 1865. Rec. Calif. & Indo-Pacific. Mioc. — Plioc., Florida & Europe.
- MITROLUMNA Bucquoy, Dautzenberg & Dollfus, 1883 (= *Clinomitra* and *Diptychomitra* Bellardi, 1889). Rec. Medit. & W. Afr. Mioc. — Pleist., Europe.
- MITRITHARA Hedley, 1922. Rec. S. & E. Austr. & N.Z.; Olig. — Plioc., Aust. & N.Z.
- subgen. ITIA Marwick, 1931. Rec. & Mioc., N.Z.
- \*VEXITHARA Finlay, 1926. Oligocene, N.Z.
- HELENELLA Casey, 1904. Rec. St. Helena.
- ZETEKIA Dall, 1918. Recent, Panama.
- ARIELIA Shasky, 1961. Recent, G. of California.
- APATURRIS Iredale, 1917. Recent, Kermadec Islands.
- LOVELLONA Iredale, 1917. Recent, Indo-Pacific.
- MAORIMORPHA Powell, 1939. Rec., New Zealand.
- ?\*AWATERIA Suter, 1917. Mioc. — Pleist., New Zealand.
- subgen. MIOAWATERIA Vella, 1954. Olig. — L. Plioc., N.Z.
- SCRINIUM Hedley, 1922. Rec. Austr. & N.Z. Olig. — Plioc., N.Z. & Austr.
- Subfamily CLAVINAE Powell, 1942**  
(= *Brachytominae* Thiele, 1929, in part)
- (a) dentition prototypic.
- CLAVUS Montfort, 1810 (= *Clavicantha* Swainson, 1840 = *Tylotia* Melvill, 1917 = *Eldridgea* Bartsch, 1934 = ? *Aliceia* Dautzenberg & Fischer, 1897). Rec., Indo-Pacific, Caribb. & Azores. Plioc. Java.
- subgenus PLAGIOSTROPHA Melvill, 1927. Rec., Indo-Pacific.
- TYLOTIELLA Habe, 1958. Rec., Indo-Pacific, Japan.
- DRILLIA Gray, 1838. Recent, W. Africa & ? Indian Ocean.
- CLATHRODRILLIA Dall, 1918. Rec. Florida, Caribb. & G. of Calif. to Ecuador. Recorded but not verified. Olig. — Plioc., Caribb., Costa Rica, Ecuador & Peru.
- SPLENDRILLIA Hedley, 1922. Rec., Indo-Pacific, Austr. & N.Z. Mioc. — Plioc.; N.Z., Austr., Java, Okinawa & Jap.
- subgen. SYNTOMODRILLIA Woodring, 1928. Rec., G. of Mex., Caribb., & trop. W. Amer. Olig. — Plioc.; Fla., Caribb., Panama, N.Z. & Austr.
- subgen. HAUTURUA Powell, 1942. Mioc. — Rec., Austr. & N.Z.
- KYLIX Dall, 1919. Rec. tropical W. America.
- IMACLAVA Bartsch, 1944. Rec. tropical W. Amer.
- NEODRILLIA Bartsch, 1943. Rec. Fla. & Caribbean.
- CERODRILLIA Bartsch & Rehder, 1939. Rec. Fla. & Caribb.
- subgen. LISSODRILLIA Bartsch & Rehder, 1939. Rec. N. Carolina—Fla. Plioc. Florida.
- VIRIDRILLIA Bartsch, 1943 (= *Viridrillina* Bartsch, 1943). Rec. N. Carolina to Bahamas.
- ELAEOCYMA Dall, 1918. Rec. Calif. to Ecuador.
- SPIROTROPIS G. O. Sars, 1878. Rec. N. Atlantic, Medit., Canary Ids., & Antarctica. Mioc. — Pleist., Eur.
- (b) dentition modified "wishbone"-type.
- CRASSISPIRA Swainson, 1840. Rec. trop. W. Amer., Galapagos & Caribb. Eoc. — Pleist.; Calif., Costa Rica, Ecuador, Peru, Florida & Mex. Also recorded Rec. Indo-Pacific and Tert. of Eur., Zanz., Burma, Indonesia & Okinawa.
- subgen. CRASSISPIRELLA Bartsch & Rehder, 1939. Rec. L. Calif., Fla. & Dominican Rep.
- subgen. MONILISPIRA Bartsch & Rehder, 1939. Rec. trop. W. Amer., Galapagos & Fla. Plioc. Fla.
- subgen. STRIOSPIRA Bartsch, 1950. Rec. trop. W. Amer.
- subgen. PILSBRYSPIRA Bartsch, 1950. Rec. Panama.
- subgen. DALLSPIRA Bartsch, 1950. Rec. trop. W. America.
- subgen. ADANACLAVA Bartsch, 1950. Rec. trop. W. America.
- subgen. ZONULISPIRA Bartsch, 1950. Rec. trop. W. Amer. & Galapagos.
- subgen. BURCHIA Bartsch, 1944. Rec. Calif. & Panama.
- (c) dentition of slender non-barbed or slightly barbed marginals.
- CARINODRILLIA Dall, 1919. Rec. trop. W. Amer.; Mioc. Fla., Dominican Rep., Jamaica, Trinidad & Panama.
- subgen. BUCHEMA Corea, 1934. Rec. Puerto Rico; Plioc. Florida.
- INQUISITOR Hedley, 1918 (= *Ptychobela* Thiele, 1925 = *Pseudoinquisitor* Powell, 1942). Rec. Indo-Pacific; Olig. — Pleist. Jap, Burma, Austr. & N.Z.
- TOMOPLEURA Casey, 1904 (= *Cryptomella* Finlay, 1924). Rec., Indo-Pacific. Paleoc. — Pleist., Jap, Austr. & N.Z.
- subgen. MAORITOMELLA Powell, 1942 (= *Naraweena* Laseron, 1954). Rec. Zanz., S.E. Aust. & N.Z. Olig. — Pleist. N.Z. & Austr.
- PHENATOMA Finlay, 1924. Olig. — Rec., N.Z.
- MICRODRILLIA Casey, 1903 (= *Acrobela* Thiele, 1925). Rec., Indo-Pacific, E. Afr. to Japan, Austr. & Caribb. Eoc. — Mioc. S.E. United States, Fla., Jamaica, Trinidad & Austr.
- SUAVODRILLIA Dall, 1918. Rec., Jap. & Alaska. Olig. — Plioc. Jap. & N.W. America.
- TYPHLOMANGELIA G. O. Sars, 1878. Rec. N. Atlantic, Caribb., S. Afr., Southern O. & Antarctica.
- (d) dentition; marginals like unfolding leaf.
- INODRILLIA Bartsch, 1943 (= *Inodrillara* & *Inodrillina* Bartsch, 1943). Rec., N. Carolina, Caribb.
- (e) dentition; marginals with point like an anchor fluke.



- HAEDROPLEURA Bucquoy, Dautzenberg & Dollfus, 1883. Rec., Britain to Medit., W. & S. Africa. Mioc. — Plioc., Eur.  
(f) dentition unknown.
- AUSTRODRILLIA Hedley, 1918. Rec., S. & S.E. Australia.  
subgen. REGIDRILLIA Powell, 1942. Rec., New Zealand.
- PARACUNEUS Laseron, 1954. Rec. S.E. Australia.
- CONTICOSTA Laseron, 1954. Rec. S.E. Australia.
- PULSARELLA Laseron, 1954. Rec., E. Australia.
- IREDALEA Oliver, 1915 (=Brepodrililla Pilsbry & Lowe, 1932). Rec., Indo-Pacific & trop. W. America.
- CARINAPEX Dall, 1924. Rec. Hawaiian Is.
- CERITOTURRIS Dall, 1924. Rec. Hawaiian Islands.
- \*AUSTROCLAVUS Powell, 1942. Olig. — Mioc., N.Z. & Austr.
- AOTEADRILLIA Powell, 1942. Olig. — Rec., N.Z. Plioc., Jap.
- \*CLAVATOMA Powell, 1942. Plioc., New Zealand.
- \*MAUIDRILLIA Powell, 1942. Olig. — Plioc., N.Z., Austr., Okinawa & Jap.
- \*MAORICRASSUS Vella, 1954. Mioc., N.Z.
- TAHUDRILLIA Powell, 1942. Eocene, New Zealand.
- \*WAIRARAPA Vella, 1954. Miocene, New Zealand.
- \*MITRELLATOMA Powell, 1942. L. Pleist., N.Z. & ?Mioc., France.
- \*INTEGRADRILLIA Powell, 1942. Mioc., Victoria, Austr.
- \*VIXINQUISITOR Powell, 1942. Mioc., Victoria, Austr.
- BRACHYTOMA Swainson, 1840. Rec., ?Panama; East Indies.
- STROMBINOTURRIS Hertlein & Strong, 1951. Rec., G. of California.
- CYMATOSYRINX Dall, 1889. Rec., Bermuda, G. of Mex. & trop. W. Amer. Eoc. — Pleist., S.E. United States & Galapagos.
- DOUGLASSIA Bartsch, 1934. Rec., Puerto Rico & Florida.
- FENIMOREA Bartsch, 1934. Rec., N. Carolina-Caribb. Plioc., Florida.
- COMPSODRILLIA Woodring, 1928. Rec. Puerto Rico. Mioc. — Plioc., N. Carolina, Jamaica & Trinidad.
- LEPTADRILLIA Woodring, 1928. Rec., Puerto Rico. Mioc., Dominican Rep. & Jamaica.
- \*GLOBIDRILLIA Woodring, 1928. Miocene, Jamaica.
- \*AGLADRILLIA Woodring, 1928. Mioc. — Plioc., Jamaica, Fla., Dominican Rep. & Okinawa?  
subgen. EUMETADRILLIA Woodring, 1928. Rec., Patagonia. Mioc., Jamaica, Florida & Panama.
- \*SEDILIA Fargo, 1953. Pliocene, Florida.
- OPHIODERMELLA Bartsch, 1944. Rec., Calif. & L. Calif. Plioc — Pleist., Calif. & Japan.
- HINDSICLAVA Hertlein & Strong, 1955. Rec., L. Calif.-Colombia.
- TURRIGEMMA Berry, 1958. Rec., L. California.
- ?TRIPIA Gregorio, 1890. Eocene, Alabama.
- CRASSOPLEURA Monterosato, 1884. Rec., Medit.-Canary Ids. Mioc. — Plioc., Eur.
- DRILLIOLA Cossmann, 1903. Rec., Medit. & B. of Biscay.
- \*BOREODRILLIA Sorgenfrei, 1958. Miocene, Denmark.
- \*MITRELOTURRIS Eames, 1957. Eocene, Nigeria.
- \*PSEUDODRILLIA Lukovic, 1924. Eocene, Southern Russia.
- \*TEREBRITOMA Cossmann, 1894. Cretaceous, Syria.

#### Subfamily CONORBIINAE Powell, 1942

- CONORBIS Swainson, 1840. Cret., S.E. United States. Eoc. — Mioc., Eur., S.E. United States, India, Java & S. Austr. ?Rec., S. India.

- \*CRYPTOCONUS Koenen, 1867. Eoc. — Mioc., Eur., India, E. Indies, N.Z., Calif. & Barbados.
- BENTHOFASCIS Iredale, 1936. Rec., Queensland to Tasmania.
- GENOTA H. & A. Adams, 1853. Rec., W. Africa. Eoc. — Plioc., Eur., Burma & Java.

#### Subfamily MANGELIINAE Fischer, 1887 (emended) (equals, in part—*Raphitominæ* Bellardi, 1875, *De-franciinae* H. & A. Adams, 1858 and *Cythinæ* Thiele, 1929).

- MANGELIA Risso, 1826 (=Vielliersia Monterosato =Villiersiella Monterosato, 1890) Rec., N. Eur. & Medit.; ?Indo-Pacific.
- BELA GRAY, 1847 (=Ishnula Gray, 1847=Smithia Monterosato, 1884 = Smithiella Monterosato, 1890=Ginnania Monterosato, 1884). Rec., Norway-Medit. & W. Afr. Plioc. — Pleist., Eur.
- \*BUCHOZIA Bayan, 1873 (=Etallonia Deshayes, 1862). Paleoc. — Eoc., Eur.
- \*ENATOMA Rovereto, 1899 (=Atoma Bellardi, 1875). Mioc., France.
- \*AMBLYACRUM Cossmann, 1899. Eoc. — Olig., Europe.
- AGATHOTOMA Crossmann, 1899 (=Ditoma Bellardi, 1877). Mioc. — Plioc., Eur. ?Rec., Calif.-Panama.
- BENTHOMANGELIA Thiele, 1925. Rec., E. Indies.
- MANGILIELLA Bucquoy, Dautzenberg & Dollfus, 1883. Rec., Medit. Eoc. — Plioc., Eur.  
subgen. LYROMANGELIA Monterosato, 1917. Rec., Mediterranean.
- CYTHARELLA Monterosato, 1875 (=Rissomangilia Monterosato, 1917). Rec., Engl.-Medit. Eoc. — Pleist., Europe.
- CLATHROMANGELIA Monterosato, 1884. Rec., Medit. Mioc., Europe.
- GLYPHOTURRIS Woodring, 1928. Rec., Fla., Caribb. Mioc., Jamaica.
- TENATURRIS Woodring, 1928. Rec., Caribb. & trop. W. Amer. Mioc., Jamaica.
- \*ACMATURRIS Woodring, 1928. Miocene, Jamaica.
- CRYOTURRIS Woodring, 1928. Rec., N. Carolina-Caribb. Mioc. — Plioc., N. Carolina, Florida, Jamaica & Dominican Rep.
- \*GRANOTURRIS Fargo, 1953. Pliocene, Florida.
- SACCHAROTURRIS Woodring, 1928. Rec., Caribb. Mioc., Fla. & Jamaica.
- NOTOCYTHARELLA Hertlein & Strong, 1955. Rec., Calif.-Ecuador.
- RUBELLATOMA Bartsch & Rehder, 1939. Rec., S.E. United States.
- STELLATOMA Bartsch & Rehder, 1939. Rec., Fla.
- KURTZIA Bartsch, 1944. Rec., Vancouver to San Diego. Pleist., San Pedro.
- KURTZIELLA Dall, 1918. Rec., N. Carolina-Fla. & California. Mioc. — Plioc., Fla. & Venezuela.
- KURTZINA Bartsch, 1944. Rec., Calif.-Panama.
- \*BELLASPIRA Conrad, 1868. Miocene, Virginia.
- GURALEUS Hedley, 1918. Mioc. — Rec., Southern Australia.  
subgen. EUGURALEUS Cotton, 1947. Rec., S.E. Austr.
- subgen. MITRAGURALEUS Laseron, 1954. Rec., S.E. Austr.
- NEOGURALEUS Powell, 1939. Olig. — Rec., N.Z. ?Mioc. — Plioc., Okinawa.
- \*subgen. FUSIGURALEUS Powell, 1942. Olig. — L. Plioc., N.Z.
- ANTIGURALEUS Powell, 1942 (=Paraguraleus Powell, 1944). Mioc. — Rec., N.Z. Olig. — Rec., Austr.
- MARITA Hedley, 1922. Rec., S.E. Austr. & Tasmania.
- \*ETREMELLA Makiyama, 1927. L. Pliocene, Japan.
- \*VEXIGURALEUS Powell, 1942. Miocene, New Zealand.

- TURRELLA Laseron, 1954. Rec., N.S.W. & Tasmania.
- LIRACRAEA Odhner, 1924. Rec. — Pleist., N.Z.
- MACTEOLA Hedley, 1918. Rec., Indo-Pacific, Austr. & N.Z.
- PSEUDORAPHITOMA Boettger, 1895. Rec., Indo-Pacific, E. & S. Austr. Plioc., Japan & Okinawa.
- ITHYCYTHARA Woodring, 1928. Rec., S.E. United States, Caribb., & Brazil. Olig. — Plioc., Fla., Jamaica & Dominican Rep.
- \*MANGAOPARIA Vella, 1954. Mioc., New Zealand.
- PARACLATHURELLA Boettger, 1895. Rec., Indo-Pac., Queensland & W. Africa.
- \*EUCLATHURELLA Woodring, 1928. Mioc., Jamaica, Dominican Rep. & Panama.
- \*subgen. MIRACLATHURELLA Woodring, 1928. Mioc., Caribb. Mexico.
- CROCKERELLA Hertlein & Strong, 1951. Rec., Calif. to G. of Calif.
- EUCITHARA Fischer, 1883 (= *Cythara* auct.). Rec., Indo-Pacific. Plioc., Java & Austr. Mioc., Borneo.
- subgen. LEIOCITHARA Hedley, 1922. Rec., Indo-Pacific.
- ANACITHARA Hedley, 1922. Rec., Indo-Pacific. Olig. — Plioc., Tasmania, N.Z., Java & Japan.
- \*subgen. ANACITHAROIDA Shuto, 1965. Pleist., Japan.
- CONOPLEURA Hinds, 1844 (= ?*Kenyonia* Brazier, 1896). Rec., Indo-Pacific.
- ETREMA Hedley, 1918. Rec., Indo-Pacific & Austr. Olig. — Plioc., Austr., ?N.Z., Jap., Okinawa & Zanzibar.
- subgen. ETREMOPA Oyama, 1953. Rec., Indo-Pacific. Plioc., Jap.
- \*ETREMOPSIS Powell, 1942. (= *Iraqetrema* Dance & Eames, 1966). Olig. — Mioc., N.Z. Mioc. — Plioc., Austr. Rec., Persian Gulf.
- PSEUDOETREMA Oyama, 1953. Mioc.—Rec., Jap., Formosa & Java.
- HETEROCITHARA Hedley, 1922. Rec., Philippines—E. Austr. & N.Z. Mioc. — Plioc., Austr. & ?N.Z.
- APITUA Laseron, 1954. Rec., N.S.W., Australia.
- APISPIRALIA Laseron, 1954. Rec., N.S.W., Austr.
- FILODRILLIA Hedley, 1922. Mioc. — Rec., S.E. Australia.
- LIENARDIA Jousseume, 1884. Rec. Indo-Pacific. Plioc., Jap. & Formosa.
- subgen. ACRISTA Hedley, 1922. Rec., Indo-Pacific.
- subgen. HEMILIENARDIA Boettger, 1895. Rec., Indo-Pacific.
- subgen. THETIDOS Hedley, 1899. Rec., trop. Pacific, Gilbert Ids.
- NANNODIELLA Dall, 1919. Rec., trop. W. Amer., Fla. & Caribb., Hawaii, Phil. Ids. & E. Indies. Mioc. — Plioc., Fla., Jamaica & Ecuador.
- GLYPHOSTOMA Gabb, 1872. Rec., Caribb. & trop. W. Amer. Mioc. — Plioc., S.E. United States & Caribb.
- subgen. GLYPHOSTOMOPS Bartsch, 1934. Rec., Puerto Rico. ?Plioc., Fla.
- CLATHURELLA Carpenter, 1857. Rec., trop. W. America.
- \*ADELOCYTHARA Woodring, 1928. Miocene, Jamaica.
- BACTROCYTHARA Woodring, 1928. Rec., Puerto Rico. Mioc., Jamaica.
- BRACHYCYTHARA Woodring, 1928. Rec., Caribb. & W. Mex. Mioc. — Plioc., Fla., Jamaica & Dominican Rep.
- LIOGLYPHOSTOMA Woodring, 1928. Rec., Caribb., Galapagos & trop. W. Amer. Mioc. — Plioc., Fla., Caribb., Costa Rica & ? Okinawa.
- \*PACHYCYTHARA Woodring, 1928. Miocene, Jamaica.
- PYRGOCYTHARA Woodring, 1928. Rec., Fla., Caribb. & trop. W. Amer. Mioc. — Plioc., Fla. & Jamaica.
- \*subgen. GLABROCYTHARA Fargo, 1953. Plioc., Florida.
- \*subgen. PLATYCYTHARA Woodring, 1928. Miocene, Jamaica.
- subgen. VITRICYTHARA Fargo, 1953. Rec. & Plioc., Florida.
- \*THELECYTHARA Woodring, 1928. Mioc.—Plioc., Jamaica, Dominican Rep. & Florida.
- \*EOCLATHURELLA Casey, 1904. Eocene, S.E. United States.
- \*PLEUROTOMOIDES Bronn, 1831 (= *Defrancia* Millet, 1826). Mioc. — Plioc., Europe.
- AUSTROPUSILLA Laseron, 1954. Rec., N.S.W. & Tasmania.
- PARAMONTANA Laseron, 1954. Rec., E. Austr., Tasm. & N. Caled.
- ?\*MAPPINGIA Ludbrook, 1941. Plioc., South Australia.
- ?CYTHAROPSIS A. Adams, 1865. Recent, Japan.
- ?THESBIA Jeffreys, 1867. Recent, North Europe.
- ?STEIRONEPION Pilsbry & Lowe, 1932. Recent, Nicaragua.
- ?AMEKICYTHARA Eames, 1957. Eocene, Nigeria.
- PROBELA Iredale, 1918 (= *Turritoma* Bartsch, 1941 = *Turritomella* Bartsch, 1941). Rec. circum-Arctic. Pleist., Engl., Plioc., Japan.
- OENOPOTA Mörch, 1852. Rec., circum-Arctic. Pleist., Calif., Plioc. — Mioc., Japan.
- subgen. FUNITOMA Bartsch, 1941 (= *Cestoma* and *Granotoma* Bartsch, 1941). Rec., Jap., Alaska & Wash. Plioc., Japan.
- OBESOTOMA Bartsch, 1941. Rec., circum-Arctic.
- NODOTOMA Bartsch, 1941 (= *Canetoma*, *Curtitoma*, *Nematoma* & *Venustoma* Bartsch, 1941). Rec., circum-Arctic. Plioc. — Mioc., Japan.
- BELALORA Powell, 1951. Rec., Falklands & Antarctica.
- LORABELA Powell, 1951. Rec., S. Georgia & Antarctica.
- ?CONORBELA Powell, 1951. Rec., Antarctica.
- Subfamily DAPHNELLINEAE Hedley, 1922**  
(equals, in part-Raphitominæ Bellardi, 1875, Defranciinae H. & A. Adams, 1858 and Cytharinae Thiele, 1929).
- DAPHNELLA Hinds, 1844 (= *Eudaphne* Bartsch, 1931 = *Eudaphnella* Bartsch, 1933 = *Paradaphne* Laseron, 1954). Rec., Indo-Pacific, Austr., N.Z., trop. W. Amer. & Caribb. Eoc. — Plioc., S.E. United States, Okinawa, Austr.
- subgen. DIAUGASMA Melvill, 1917. Rec., Gulf of Oman.
- subgen. HEMIDAPHNE Hedley, 1918. Rec., Indo-Pacific.
- AUSTRODAPHNELLA Laseron, 1954. Rec., N.S.W., Australia.
- TASMADAPHNE Laseron, 1954. Rec., N.S.W., Australia.
- \*HOKIANGA Laws, 1947. Olig., New Zealand.
- FUSIDAPHNE Laseron, 1954. Rec., N.S.W., Australia.
- \*RIMOSODAPHNELLA Cossmann, 1915. Pliocene, Italy.
- \*FAVRIELLA Hornung, 1920. L. Pliocene, Italy.
- \*METUONELLA Sorgenfrei, 1958. Miocene, N. Europe.
- RAPHITOMA Bellardi, 1848. Rec., Medit.-Madeira. Plioc., Engl. & France.
- ?OTITOMA Jousseume, 1898. Rec., Red. Sea.
- VEPRECULA Melvill, 1917 (= *Mordica*, Dall, 1924). Rec., Indo-Pacific, Austr. & N.Z.
- TERETIA Monterosato, 1890 (= *Teres* Bucquoy, Dautzenberg & Dollfus, 1883). Rec., Norway-Canary Ids. Mioc. — Plioc., Eur.



NEPOTILLA Hedley, 1918. Rec., Austr. & N.Z. Plioc., S. Austr., Olig., N.Z.  
 MICROGENIA Laceron, 1954. Rec., N.S.W., Austr.  
 STILLA Finlay, 1926. Recent, New Zealand.  
 ZENEPOS Finlay, 1928. Rec., N.Z., Tasm., S. Austr. & ?S. Afr. Pleist., N.Z.  
 CRYPTODAPHNE Powell, 1942. Rec., E. Indies. Up. Olig., N.Z.  
 ISODAPHNE Laceron, 1954. Rec., N.S.W., Austr.  
 ASPERDAPHNE Hedley, 1922 (= *Scabrella* Hedley, 1918). Rec., Austr., N.Z., E. Indies, Hongkong & Jap. Mioc., Austr.  
 subgen. ASPERTILLA Powell, 1944. Rec., Tasmania. Plioc., S. Aust.  
 FENESTRODAPHNE Powell, 1944. Plioc., South Australia.  
 PSEUDODAPHNELLA Boettger, 1895. Rec., Indo-Pacific, Austr. & Tasmania.  
 CACODAPHNELLA Pilsbry & Lowe, 1932. Rec., Nicaragua.  
 TRITONOTURRIS Dall, 1924. Rec., Indo-Pacific, S. Africa to Hawaii.  
 XANTHODAPHNE Powell, 1942. Recent, New Zealand.  
 EUBELA Dall, 1889. Rec., Florida-Brazil, Panama, Indo-Pacific. Mioc., N.Z. & Europe.  
 TYPHLODAPHNE Powell, 1951. Rec., Patagonia & Southern O. to Kerguelen.  
 BENTHODAPHNE Oyama, 1962. Plioc., Japan.  
 EUCYCLOTOMA Boettger, 1895 (= *Turrhyssa* Dall, 1924). Rec., Indo-Pacific.  
 \*MAORIDAPHNE Powell, 1942. Olig. — Mioc., New Zealand.  
 subgen. KUROSHIODAPHNE Shuto, 1965. Rec. & Pleist., Japan.  
 \*PUHA Marwick, 1931. Olig. — Mioc., New Zealand.  
 \*MAGNELLA Dittmer, 1960. Mioc., North Germany.  
 PLEUROTOMELLA Verrill, 1873. Rec., N. & S. Atlantic, Southern O. & Indo-Pacific.  
 \*subgen. SYSTENOPE Cossmann, 1889. Eocene, France.  
 subgen. THETA Clarke, 1959. Rec., off Bermuda.  
 subgen. ANTICLINURA Thiele, 1934 (= *Clinuropsis* Thiele, 1929 = *Clinuromella* Beets, 1943). Rec., Panama-Peru, in deep water.  
 subgen. ANOMALOTOMELLA Powell (nov.). Rec., S. Atlantic-Antarctica.  
 GYMNOBELA Verrill, 1884. Rec., New England, Fla., Caribb., G. of Guinea, S. Afr., Zanz., Panama, Galapagos & Peru.  
 PHYMORHYNCHUS Dall, 1908. Rec., off Ecuador, Galapagos, Panama & N. Pacific, in deep water.  
 \*EURYENTMEMA Woodring, 1928. Miocene, Jamaica.  
 \*BUCCINARIA Kittl, 1887. Mioc. — Plioc., Austria, Java & Okinawa.  
 subgen. OOTOMELLA Bartsch, 1933 (= *Ootoma* Koperberg, 1931 = *Pionotoma* Kuroda, 1952). Rec., E. Indies-Jap. Olig. — Mioc., E. Indies & Okinawa.  
 PHILBERTIA Monterosato, 1884 (= *Cirillia* Monterosato, 1884 = *Cordieria* Monterosato, 1884 = *Homotoma* Bellardi, 1875 = *Leufroyia* Monterosato, 1884 = *Peratotoma* Harris & Burrows, 1891). Rec., Norway to Medit. & W. Afr. Mioc. & Plioc., Eur.  
 KERMIA Oliver, 1915 (= *Clathurina* Melvill, 1917). Rec., Indo-Pacific.  
 ANTIMITRA Iredale, 1917. Rec., Indo-Pacific.  
 COMARMONDIA Monterosato, 1884 (= *Bellardia* Bucquoy, Dautzenberg & Dollfus, 1883 = *Bellardiella* Fischer, 1883 = *Bellatula* Strand, 1928). Rec., Engl. to Medit. & Canary Ids. Mioc. — Pleist., Eur.  
 PONTIOTHAUMA Smith, 1895. Rec., Indian I. to Antarctica.

SPERGO Dall, 1895. Rec., off Hawaii & Japan. Mioc. — Plioc., Okinawa.  
 subgen. SPOIDES Kuroda & Habe, 1961. Rec., off Jap.-Philippines.  
 SURCULINA Dall, 1908. Rec., Calif. to G. of Panama.  
 \*PHANDELLA Casey, 1903. Oligocene, Mississippi.  
 EXOMILUS Hedley, 1918. Rec., S. Aust. to Queensland.  
 PSEUDEXOMILUS Powell, 1944. Rec. — Plioc., South Australia.  
 \*RUGOBELA Finlay, 1924. Eoc. — Mioc., N.Z. Olig. Victoria & Tasmania.  
 TELEOCHILUS Harris, 1897 (= *Litachilus* Powell, 1944). Olig. — Rec., S.E. Australia & Tasmania.  
 \*SYNGENOCHILUS Powell, 1944. Olig., Victoria Australia.  
 ?\*DAPHNOBELA Cossmann, 1896. Eocene, England.  
 ?BATHYCLIONELLA Kobelt, 1905 (= *Cryptomitra* Dall, 1924). Rec., Azores, Zanzibar, Timor Sea and off Hawaii.

#### Subfamily THATCHERIINAE Powell, 1942

(emended to subfamily rank, Charig, 1963)

\*CLINURA Bellardi, 1875. Mioc. — Plioc., Eur. Mioc. — Olig., E. Indies & N.Z.  
 THATCHERIA Angas, 1877 (= *Cochlioconus* Yokoyama, 1928). Mioc. — Rec., Jap., Borneo, Fiji & N.Z.  
 \*subgen. WAITARA Marwick, 1931. Mioc., N.Z.

#### GENERA CONSIDERED TO BE DOUBTFULLY TURRID

*Beisselia* Holzapfel, 1889 (= *Koenenia* Holzapfel, 1888), *Daphnellopsis* Schepman, 1913, *Eothesbia* Finlay & Marwick, 1937, *Exilia* Conrad, 1860, *Fusitoma* Casey, 1904, *Heterotoma* Gabb, 1868, *Horacivus* Oyama, 1954, *Nekewis* Stewart, 1926, *Pyramitoma* Martin, 1914, *Tritonimangelia* Martin, 1914, *Varicobela* Casey, 1904 and *Zexilia* Finlay, 1927.

#### NOMINA NUDA AND UNAUTHENTICATED GENERA FORMERLY REFERRED TO THE TURRIDAE

"*Corbulospira* Vincent, 1913", Gardner, 1931, "*Diploconus* Sandberger", Dall, 1918, *Lora* Gistel, 1848, *Melatoma* Swainson, 1840, *Pleurotomina* (Beck?) 1847, *Pseudogemmula* (Dall, ms.) Grant & Gale, 1931 and *Strombina* Gregorio, 1890.

#### GENERA EITHER PROPOSED AS TURRIDS OR SUBSEQUENTLY REFERRED TO THAT FAMILY, BUT NOW CONSIDERED TO BE NON-TURRID

*Anarithma* Iredale, 1916 (Columbellidae); *Anna* Risso, 1826 (Buccinidae); *Chauvetia* Monterosato, 1884 (= *Nesaea* Risso, 1826 = *Folineaea* Monterosato, 1884) (Buccinidae); *Columbarium* Martens, 1881 (Columbariidae); *Cymakra* Gardner, 1937 (Mitridae); *Donovania* Bucquoy, Dautzenberg & Dollfus, 1883 (Buccinidae); *Drilluta* Wade, 1916 (= *Drilliovoluta* Cossmann, 1925) (Fascioliariidae); *Fulgerca* Stephenson, (Olividae); *Gosavia* Stoliczka, 1866 (Volutidae); *Kryptos* Dautzenberg & Fischer, 1896 (Fascioliariidae); *Mesochilotoma* Seeley, 1861 (Aporrhaidae); *Michela* Gardner, 1945 (Fascioliariidae); *Palaeorhaphis* Stewart, 1927 (Volutidae or Mitridae); *Pholidotoma* Cossmann, 1896 (Volutidae); *Priscofus* Conrad, 1865 (Fascioliariidae); *Puruiana* Martin, 1931 (Mitridae); *Rhombopsis* Gardner, 1916 (= *Nepetunella* Meek, 1864) (Melongenidae); *Ruscula* Casey, 1904 (Fascioliariidae); *Savatieria* Rochebrune & Mabile, 1885 (Buccinidae); *Surculites* Conrad, 1865 (?Fascioliariidae); *Surculofusus* Vincent, 1895 (Fascioliariidae); *Turriculina* Gregorio, 1930 (Coelostyliidae); *Utleya* Marwick, 1934 (Muricidae).



### Family SPEIGHTIIDAE Powell, 1942

The Speightiidae contains three genera, *Andicula* from the Negritos lower Eocene of Peru, *Clinuropsis* from the Paleocene of Belgium, the Congo, and the Eocene of Egypt, and finally *Speightia* from the Bortonian middle Eocene of New Zealand.

They are large broadly biconic-fusiform shells, having much the appearance of fasciolarids, especially in a similar thickening of the pillar ridge. The fasciolarids, however, have at most, a broad shallow labial concavity, that extends over most of the shoulder slope.

In the Speightiidae there is a definite sinus, situated on the shoulder slope, and this is much deeper than in any fasciolarid, being very broadly V-shaped, its apex narrowly rounded and situated just above the peripheral carina.

The Speightiidae appear to be a parallel development with the Turridae, a gerontic offshoot that became extinct in the Eocene.

#### Genus ANDICULA Olsson, 1929,

Bull. Amer. Paleont. 15, no. 57, p. 94. Type (o.d.) *Surcula occidentalis*, Woods, 1922.

##### Plate 1, fig. 4

The genus is strikingly similar to *Speightia*, being of similar shape, large size and solidity. The main points of difference from *Speightia* are roundly pointed peripheral tubercles, not vertically compressed, and a much deeper sinus, but with its apex similarly, just above the peripheral carina. Both genera have an entering parietal spiral ridge, but *Andicula* seems to lack the thickened ridge along the edge of the columella. That there is very close affinity between *Andicula* and *Speightia* can scarcely be doubted. Range — Three species from the Negritos lower Eocene of Peru.

#### CHARACTERISTIC SPECIES—

*occidentalis* and *thomsoni* (Woods, 1922), *olssoni* Rivera, 1956.

#### Genus CLINUROPSIS Vincent, 1913,

Ann. Mus. Congo Belg. Géol. Pal. Min., 3, 1, p. 22. Type (o.d.) *Pleurotoma ampla* Briart & Cornet, 1871.

##### Plate 1, figs. 2,3

Shell very large, up to 125 mm., solid, broadly biconic-fusiform, with a broadly conical pagodiform spire, strongly tuberculate-carinate just above the lower suture, and a relatively long flexed unnotched anterior canal. Peripheral nodes rather sharp, vertically compressed. Sinus distinct, very broadly U-shaped, its apex on the shoulder slope, nearer to the periphery than to the upper suture. Range—Paleocene of Belgium (type) and the Belgian Congo, and possibly the Eocene of Egypt.

#### CHARACTERISTIC SPECIES—

Paleocene-*ampla* (Briart & Cornet, 1871), *diderrichi* Vincent, 1913. Eocene-? *ingens* (Mayer-Eymar, 1895).

The three genera, *Andicula*, *Clinuropsis* and

*Speightia* seem to be closely allied, there being just slight differences in the depth, position and roundness of the apex of the sinus.

In *Andicula* the sinus is rather deep, with its narrowly rounded apex just above the peripheral carina. In *Speightia* it is similar but rather more shallow, and more broadly rounded at its apex, which likewise is just above the peripheral carina. In *Clinuropsis* the sinus is similar to that of *Speightia* but with a still broader and shallower apex, which is just below the middle of the shoulder slope. These differences are slight, however, and better material may reveal that all three are generically identical.

#### Genus SPEIGHTIA Finlay, 1926,

Trans. N.Z. Inst. 56, p. 252. Type (o.d.) *Euthriofusus spinosus* Suter, 1917.

##### Plate 1, fig. 1

Shell very large, up to 95 mm., solid, broadly biconic-fusiform, with a broadly conical spire, strongly tuberculate-carinate just above the lower suture, which imparts a depressed pagodiform appearance to the spire. Body-whorl sharply angled, the angle bearing large vertically compressed and slightly upcurved sharp tubercles, quickly contracted to a relatively long, slightly flexed and recurved anterior canal, with an unnotched termination. Protoconch described as small, pointed, of two whorls (no well preserved apices available). Sinus distinct, very broadly V-shaped, its apex narrowly rounded, just above the peripheral carina. Features of the shell are a thickened ridge which lies along the inner edge of the columella, and a spiral entering parietal ridge, which does not end in a tubercle. Range — Known only by the type species from the Bortonian middle Eocene of the Waihao River, South Island, New Zealand.

### Family TURRIDAE Swainson, 1840 (emended),

#### Subfamily TURRICULINAE Powell, 1942

(Syn. *Cochlespirinae* Powell, 1942)

The members of this subfamily are shells of moderate to large size, mostly of narrowly fusiform shape, with a tall spire and a long flexed to straight anterior canal. Typically the sinus is deep, rounded to U-shaped, and always situated upon the shoulder slope, often occupying most of it.

The radula has a formula of either 1+0+0+0+1 or 1+0+1+0+1, the central tooth being absent, vestigial or large, with a broad rectangular base. The marginals are either simple wishbone-shaped or with one of the basal limbs severed.

Typically, the operculum is clavatulid, i.e., with a medio-lateral nucleus, incurved below



in *Marshallena*, or leaf-shaped with a terminal nucleus in *Comitas*.

The subfamily is of wide distribution, both Recent and fossil, and was already well represented as early as the upper Cretaceous.

The clavatulids, which probably originated from turriculid stock in the Oligocene, have retained the clavatulid operculum exclusively, but most of the turriculid genera have developed the leaf-shaped operculum with the terminal nucleus.

Since the central tooth has proved to be an unstable element in *Gemmula* and other members of the Turrinae and Turriculinae, the presence of a large broad based central in the "Cochlespirinae" has lost its significance. The members of that so-called subfamily are now considered to be not very distinctive from the branch of the turriculids that possess a leaf-shaped operculum with a terminal nucleus.

The cochlespirinid group of genera are now shown to differ from the turriculids only in the minor point of their sharp peripheral carina, which is often serrated or even coronated, but this feature is scarcely of subfamily significance. It is also worthy of note that a large central tooth is not an invariable feature in this group, for in *Steiraxis*, an obvious close relative of *Aforia*, the central is reduced to a minute plate.

#### Genus TURRICULA Schumacher, 1817,

Essai d'un Nouv. Syst. p 217. Type (monotypy) *Turricula flammea* Schumacher, 1817 (= *Murex javanus* Chemnitz, non Linnaeus, 1767 = *Murex tornatus* Dillwyn, 1817). Syns. *Surcula* H. & A. Adams, 1853, Genera Rec. Moll. 1, p. 88. Type (s.d. Cossmann, 1896) *Murex javanus* Linnaeus, 1767 (= *Pleurotoma nodifera* Lamarck, 1822) and *Surgula* Weinkauff, 1875, Conch. Cab. ed. 2, 4 (3) (merely a transliteration).

#### Plate 1, figs. 5, 6

Large-sized shells, up to 85 mm., fusiform, with a tall, often turreted spire and a long straight or slightly flexed anterior canal. In shape these shells resemble *Lophiotoma*, *Gemmula* or *Turris*, except for the sinus, which is on the shoulder slope, not the peripheral carina or a minor rib immediately above it, as in *Turris*. The sinus in *Turricula* is moderately deep, widely open, U-shaped, with its lower edge confluent with an arcuate forward sweep of the lower outer lip. Protoconch small, erect, broadly conical of 2 - 2½ smooth whorls. Adult sculpture varying from almost smooth to strong spirals, which are often rendered gemmate to nodulose by axials, the strongest development being peripheral. The operculum is ovate, pointed top and bottom, and has a medio-lateral nucleus.

Radula (text figs. B1-5) of wishbone-type, with or without a vestigial to fully formed unicuspid central, having winged extremities. Typically there is a pair of marginals only,

which are elliptical, sharply pointed above, and thickened down each side, so that the whole is wishbone-shaped, but with the extremities connected by an insertion plate. In *catena* and *fulminata* the marginals have the distal basal limb severed, and the central is vestigial. In *javana* the marginals have the severed distal limb also, but there is a well formed unicuspid central with wide but narrow up-curved wing-like extensions. In *spurius* the distal limb of the marginal is apparently only partially severed, and the central is narrow with upcurved edges, giving a tricuspid appearance.

Range — Recent, Persian Gulf and Mauritius, tropical Indian Ocean generally to Japan and Western Australia to Queensland. Also recorded from tropical west America and the South Atlantic, but some, if not all of these, possibly belong to other genera. Pliocene, of Java, Miocene of India, Burma and Java and Eocene of India. Also recorded extensively from the Paleocene to the Miocene of Europe and the lower Tertiary of the United States, but again other genera may be concerned.

The operculum, with its medio-lateral nucleus suggests *Clavatula*, but in that genus the suture rides high on the preceding whorl, and is submargined by a very heavy, often nodulous, fold. A very similar genus to *Turricula* on shell characters is *Comitas*, but it has a leaf-shaped operculum, with a terminal nucleus.

#### CHARACTERISTIC SPECIES—

Recent — INDO-PACIFIC; *aethiopica* (Thiele, 1925); *catena* (Reeve, 1843); *ceylonica* (Smith, 1877); *gemmulaeformis* (Thiele, 1925); *javana* (Linnaeus, 1767) (= *nodifera* Lamarck, 1822); *navarchus* (Melvill & Standen, 1903); *nelliae* (Smith, 1877) and subspp. *granobalteus* and *spurius* (Hedley, 1922) (= *tuberculata* Gray, 1839); *profundorum* (Smith, 1896); *sumatrana* (Thiele, 1925); *tornata* (Dillwyn, 1817) (= *flammea* Schumacher, 1817) and subsp. *fulminata* (Kiener, 1839-40). Pliocene-JAVA; *tornata atjehensis* Oostingh, 1938; *javana tegalensis* (Martin, 1895). Miocene-BURMA; *promensis*, *sethuramae* and *thangaensis* (Vredenburg, 1921); INDIA; *culleni* (Dey, 1962); *voyseyi* (d'Archiac & Haime, 1854); JAVA; *kelirensis* (Martin, 1916). Eocene-INDIA; *blagrovei* (Vredenburg, 1921).

In addition to the above there are many Recent Indian Ocean and Tertiary Indian and Indonesian species that may be provisionally located in the genus.

#### Genus PARADRILLIA Makiyama, 1940,

Journ. Geol. Soc. Japan, 47, pp. 133, 134. Type (o.d.) *Drillia dainichiensis* Yokoyama, 1923. Syn. *Alticlavatula* Mac Neil, 1960, U.S. Geol. Surv. Prof. Paper 339, p. 109. Type (o.d.) *Pleurotoma patruelsi* Smith, 1875.

#### Plate 1, fig. 9

Shell of small to moderate size, 8-27 mm., claviform, with a tall turreted spire but a truncated body-whorl, terminated in a short, boardly and shallowly notched anterior canal. Protoconch of 1½ - 2½ smooth and polished



whorls, carinate or subcarinate towards its close, followed by a quarter whorl of brephic axials. Sinus deep, with a broadly rounded apex, occupying most of the shoulder slope. Adult sculpture of narrowly rounded spirals crossed by lamellate axials, thickened medially and mostly nodular or tubercular at the peripheral angle; sometimes fenestrate or finely gemmate over the rest of the shell. Operculum ovate, with a medio-lateral nucleus. *Paradrillia* closely resembles *Vexitomina* but that genus has a leaf-shaped operculum with a terminal nucleus. Range — Recent, Madagascar, Persian Gulf to Japan and Queensland, Pliocene of Formosa, Okinawa and Japan and Miocene of Java.

#### CHARACTERISTIC SPECIES—

Recent — *agalma* (Smith, 1906); *alluaudi* (Dautzenberg, 1932); *celebensis* (Schepman, 1913); *dainichiensis* (Yokoyama, 1923); *inconstans* (Smith, 1875) and subsp. *prunulum* (Melvill & Standen, 1901) (= *gaylordae* Preston, 1905); *lithoria* (Melvill & Standen, 1903); *nivalioides* (Yokoyama, 1920); *patruelis* (Smith, 1875) (= *consimilis* Smith, 1879). Pliocene-JAPAN; *astuta* (Yokoyama, 1928); *astutoida* (Shuto, 1961); *convexiuscula* (Shuto, 1961); *dainichiensis* (Yokoyama, 1923); *himea* (Makiyama, 1927); *kakegawensis* (Makiyama, 1927); *minoensis* (Shuto, 1961); *nivalioides* (Yokoyama, 1920). FORMOSA and OKINAWA; *taiwanensis* (Nomura, 1935). Miocene-JAVA; *djocdjocartae* (Martin, 1884); *ermelingi* (Martin, 1884).

Genus MAKIYAMAIA (Kuroda ms.) MacNeil, 1960.

U.S. Geol. Surv. Prof. Paper 339, p. 106. Type (o.d.) *Pleurotoma coreanica* Adams & Reeve 1850.

#### Plate 1, fig. 12

Shell of moderate size, 18-34 mm., fusiform, with a tall pagodiform spire, strongly angulated, usually nodulose, situated almost at the lower suture. Body-whorl rather short, rapidly excavated to a relatively short, flexed, unnotched anterior canal. Protoconch paucispiral, subnaticoid and smooth. Adult sculpture with the low-set bluntly rounded carina, either smooth or nodulose. Aperture pyriform, with a thin outer lip. Sinus moderately deep and narrowly U-shaped, its apex nearer to the periphery than to the suture. Operculum clavatulid, ovate-lunate, with narrowly rounded ends and a medio-lateral nucleus, on the columellar side. Range — Recent, Japan to the Philippines and South China Sea, Miocene-Pliocene of Okinawa and Eocene to Miocene of Japan.

#### CHARACTERISTIC SPECIES—

Recent — *coreanica* (Adams & Reeve, 1850), *subdeclivis* (Yokoyama, 1926). Miocene-Pliocene-*coreanica* subsp. *okinavensis* Mac Neil, 1960, *subdeclivis* subsp. *acuticarinata* Shuto, 1961. Eocene-Oligocene-*aritaensis* and *kurodae* Shuto & Ueda, 1963.

Genus MARSHALLENA Allan, 1927,

Trans. N.Z. Inst. 57, p. 291. Type (monotypy) *Daphnella neozelanica* Suter, 1917. Syns. *Marshallena* Finlay, 1927, Trans. N.Z. Inst. 57, p. 413. Type (o.d.)

*Daphnella neozelanica* Suter, 1917 (anticipated by Allan, 1927). *Sugitania* Kuroda, 1958, Venus 20(2), pl. 21, fig. 15. Type (monotypy) *Sugitania reticulata* Kuroda, 1958. *Sugitanitoma* Kuroda, 1959, Venus, 20(4), p. 333, nom. nov. for *Sugitania* Kuroda, 1958 (non Matsumura, 1926).

#### Plate 1, figs. 14, 15

Shell of moderate to large size, 14 - 78 mm., fusiform-biconic, with medially angulate to subangulate turreted whorls, sculptured with closely spaced regular, narrowly crested axial folds, crossed by dense spiral cords and threads. Body-whorl slowly tapered to a moderately long slightly flexed unnotched anterior canal. Sinus weak, a broad shallow concavity, occupying most of the shoulder slope. Protoconch regularly conic of 3 - 5 almost smooth whorls. Operculum small, thin, corneous, ovate, with a subterminal nucleus that curves inward towards the columella. Radula, a pair of simple wishbone-type marginals (*nierstraszi* text fig. B14); the basal limbs bridged by a thin plate (*nereis* text fig. B15). Range — typically, New Zealand, Eocene to lower Pliocene. Recent, four species from deep-water, 100-1788 metres, Gulf of Aden to Japan; also questionably from off S.W. Australia in 1950 fathoms.

#### CHARACTERISTIC SPECIES—

Tertiary — *anomala* Powell, 1942; *austrotomoides* Powell, 1931; *carinaria* Powell, 1935; *celsa* Marwick, 1931; *curtata* (Marwick, 1926); *decens* Marwick, 1931; *esdailei* (Marwick, 1926); *impar* Powell, 1942; *neozelanica* (Suter, 1917) (= *incertus* Marshall, 1919); *serotina* (Suter, 1917). Recent — *nierstraszi* (Schepman, 1913); n.spp. Powell (ms.); *nereis* (E. A. Smith, 1906) and subsp. *reticulata* (Kuroda, 1959);? *lepta* (Watson, 1881).

Genus MARSHALLARIA Finlay & Marwick, 1937,

New Zealand Geol. Surv. Pal. Bull. 15, p. 83. Type (o.d.) *Verconella spiralis* Allan, 1926.

#### Plate 1, fig. 13

Shell of moderate size, 17 - 48 mm., biconic-fusiform, with a turreted spire, a strong peripheral angulation, and a capacious body-whorl, gradually contracted to a moderately long unnotched anterior canal. Adult sculpture is of fairly prominent axials overridden by numerous spiral cords and threads. Protoconch dome-shaped of about 3½ whorls, first 1½ whorls smooth, the remainder with strong spiral cords. Sinus regularly shallowly concave, occupying the shoulder slope. The genus closely resembles *Marshallena*, which however, has a less definite sinus and a regularly conic protoconch of 3 - 5 almost smooth whorls.

*Marshallaria* is confined to the New Zealand Tertiary, with a range from the Paleocene to the upper Oligocene, but *Marshallena*, which in New Zealand, ranges from the middle Eocene to the lower Pliocene is now claimed to have Recent deep-water members, occurring from the Gulf of Aden to Japan.



## CHARACTERISTIC SPECIES—

Paleocene - *multicincta* (Marshall, 1917. Eocene - *formosa* (Allan, 1926); *senilis* (Marshall & Murdoch, 1920); *spiralis* (Allan, 1926); *uttleyi* (Allan, 1926). Oligocene - *senta* Powell, 1942; *waitakiensis* Powell, 1942.

## Genus NOTOGENOTA Powell, 1942,

Bull. 2, Auck. Inst. Mus. p. 78. Type (o.d.) *Hemifusus* (Mayeria) *goniodes* Suter, 1917.

## Plate 1, figs. 16, 17

Shell of moderate to large size, 30-75 mm., with a moderately tall spire of medially strongly carinated whorls, and a long narrow body-whorl, gradually tapered to a long straight unnotched anterior canal. Protoconch large, conical, of five convex smooth whorls, with a minute styliform tip, and weak thin axial threads developing over the last half whorl. Adult sculpture of numerous flat-topped protractively oblique axials, that extend from suture to suture, are weaker over the concave shoulder slope, and fade out over the base. The whole surface is overridden by spirals, fine threads on the shoulder slope, gradually strengthening to cord strength on the neck and anterior end. Suture slightly adpressed but only weakly margined. Aperture long and narrow; outer lip thin, with a broad shallowly concave sinus, which occupies the whole of the shoulder slope. Range — middle and upper Eocene of New Zealand.

## CHARACTERISTIC SPECIES—

*finlayi* Powell, 1942, *goniodes* (Suter, 1917) (= *antegypsata* Suter, 1917) and *pahiensis* Powell, 1942.

The genus has a superficial resemblance to *Genota*, but the large conical multispiral protoconch and broad shallow sinus suggest relationship in the vicinity of the turriculid genera *Marshallena* and *Marshallaria*.

## Genus IWAOA Kuroda, 1953,

Venus 17 (4), p. 180. Type (monotypy) *Iwaoa reticulata* Kuroda, 1953.

## Plate 1, fig. 10

Shell of moderate size, 24 - 25 mm., bucciniform, with a tall spire, almost twice the height of the aperture, and a truncated base, with a short slightly flexed unnotched anterior canal. Protoconch unknown. Adult whorls medially angulated, and sculptured with numerous regular slightly arcuate obtuse axial plicae, which gradually disappear towards the sutures, overridden by a few spiral cords which become nodulose at the points of intersection with the axials. Aperture ovate, with a heavy varix behind the outer lip. Sinus broad and very shallow, just a slight insinuation between the suture and the periphery. Colour pale fleshy-brown. Operculum yellowish-corneous, leaf-shaped with a terminal nucleus. Radula (text fig. B16), a pair of marginals of simple "wish-

bone" type, not severed into two components. Range — Known only by the type species, which is from 150 fathoms off Tosa, Japan.

The genus is probably related to both *Marshallena* and *Paradrillia* but differs from both in having a variced outer lip and a different operculum; *Marshallena* is of biconic-fusiform shape and has an operculum with an incoiled subterminal nucleus; *Paradrillia* is bucciniform but has a true Clavatulid operculum with a medio-lateral nucleus.

## Genus COMITAS Finlay, 1926,

Trans. N.Z. Inst. 56, p. 251. Type (o.d.) *Surcula oamarutica* Suter, 1917 = *Drillia fusiformis* Hutton, 1877. Syn. *Carinacomitas* Powell, 1942, Bull. 2, Auck. Inst. Mus., p. 60. Type (o.d.) *Pleurotoma clarae* Tenison-Woods, 1880.

## Plate 1, figs. 7, 8

Shell moderately large to very large, up to 95 mm., elongate-fusiform, with a tall spire and moderately long straight to slightly flexed, unnotched anterior canal. Protoconch papillate, of two smooth whorls, carinate or subcarinate over the last whorl. Adult sculpture of long fold-like axials, crossed by dense spiral lirae. Suture submargined by a very weak fold at most. Sinus moderately deep, rather broadly U-shaped, on the shoulder slope, but nearer to the periphery than to the suture. Operculum leaf-shaped, with a terminal nucleus. Radula (text figs. B6, 7) of "wishbone"-type, paired marginals but with the distal limb detached, as in *Turricula*. The animals of two deep water species have been examined, in one, *onokeana vivens*, a New Zealand species from 260 fathoms, it is blind, but a new species from a similar depth, off the Aru Islands, has well developed eyes, stepped midway on the outer edge of short broad-based cephalic tentacles.

The subgenus *Carinacomitas* was proposed for the reception of species with a carinated protoconch, as opposed to the supposed non carinate apex of typical *Comitas*. However it has since been pointed out, firstly by Vella (1954, Trans. Roy. Soc. N.Z. 81 (4), p. 548) and later by Marwick (1965, N.Z. Geo. Surv. Pal. Bull. 39, p. 42), that the protoconch of *fusiformis* varies from globose to sharply keeled, and so *Carinacomitas* must be considered a synonym of the typical genus.

Unless the opercular and nuclear characters are known it is often difficult to distinguish between *Turricula* and *Comitas*, except for a general observation that in the latter, the adult sculpture tends to consist of long fold-like axials, crossed by a surface sculpture of closely spaced rather weak spiral lirations or striations. In *Turricula* the adult sculpture is mostly a combination of strong axials and spirals, with the former relatively short, often resulting in peripheral nodulation. Range — typically New Zealand, upper Oligocene to Recent, Eocene



to Miocene of southern Australia and Tasmania, Miocene of Java, Miocene and Pliocene of Japan and Okinawa, and the deeper waters of the Indo-Pacific from South Africa to Japan.

In general terms, *Turricula* inhabits the shallow warm waters of the Indo-Pacific, and *Comitas*, the deeper and cooler waters of approximately the same area and southward to Australia and New Zealand.

#### CHARACTERISTIC SPECIES—

Recent (New Zealand) — *onokeana vivens* Dell, 1956, *trailli* (Hutton, 1873) (= *verrucosa* Suter, 1899), (Indo-Pacific) — *anterioridion* (Watson, 1881), *arcana* and *breviplicata* (Smith, 1899), *chuni* (Martens, 1902), *eurina* (Smith, 1899), *n.sp* Powell (ms.), *kaderlyi* (Lischke, 1872), *kamakurana* (Pilsbry, 1895) (= *laysanica* Dall, 1919), *kuroharai* (Oyama, 1962), *lurida* (Adams & Reeve, 1850), *margaritae* (Smith, 1904), *melvilli* (Schepman, 1913), *murrawolga* (Garrard, 1961), *pagodaeformis* (Schepman, 1913), *saldanhae* (Barnard, 1958), *sibogae* (Schepman, 1913), *stolida* (Hinds, 1843), *symbiotes* (Wood-Mason & Alcock, 1891) and subsp. *subcorpulenta* (Smith, 1894), *thisbe* (Smith, 1906). Pliocene (New Zealand) — *allani* Powell, 1942, *bilix* Marwick, 1931, *declivis* Powell, 1931, *onokeana* and *solitaria* (King, 1933), (Japan) — *habei* and *miyazakiensis* Shuto, 1961, *sobrina* (Yokoyama, 1923). Miocene (New Zealand) — *abnormis* and *imperfecta* King, 1933, *latescens* (Hutton, 1873), *subcarinapex* Powell, 1942, *terrisae* Vella, 1954, (Australia) — *clarae* (Tenison-Woods, 1880), *salebroso* (Harris, 1897), (Java) — *hillegondae* (Martin, 1931), (India) — *kayalensis* (Dey, 1962). Oligocene (New Zealand) — *fusiformis* (Hutton, 1877) (= *huttoni* Suter, 1914, and *oamarutica* Suter, 1917), *latiaxialis* (Marshall, 1918), *kaipara* Laws, 1939, (Australia) — *crenularoides* (Pritchard, 1896), *pseudoclarae* and *torquayensis* Powell, 1944, *wynyardensis* (Pritchard, 1896). Eocene (South Australia — *aldingensis* Powell, 1944.

In addition to the above a large number of Indo-Pacific Recent and Tertiary species could be referred to this genus provisionally.

#### Genus ANTICOMITAS Powell, 1942,

Bull. 2, Auck. Inst. Mus. p. 61. Type (o.d.) *Anticomitas vivens* Powell, 1942.

##### Plate 1, fig. 11

Shell small, 9.5 mm., robust, fusiform with a turreted spire and a relatively short straight unnotched anterior canal. Protoconch smooth of 2½ whorls, first whorl low and rounded, with a slight angulation just above the suture; this develops into a sharp carina at the lower fourth of the remaining 1½ whorls, and then curves upward to a central position over a short brephic stage. Sinus broad and shallow, occupying most of the shoulder slope. Adult sculpture of strong erect axials stopped at the shoulder, crossed by equally strong spiral cords, which override the axials, forming laterally elongated nodes. Colour uniformly buff. The genus differs from *Comitas* in the more depressed and very strongly carinate protoconch. Range; known only by the type specimen which is from 140 fathoms off the Three Kings Islands, New Zealand.

Genus PARACOMITAS Powell, 1942,  
Bull. no. 2, Auck. Inst. Mus. p. 61. Type (o.d.)  
*Surcula castlecliffensis* Marshall & Murdoch, 1919.

##### Plate 2, fig. 1

Shell moderate sized to relatively large 10 - 44 mm., of light build, elongate-fusiform, with a tall turreted spire and a long, almost straight, unnotched anterior canal. Protoconch of 2½ whorls, dome-shaped, sharply submedially carinated throughout, and ending with a well defined edge, which sweeps arcuately forward to a partly immersed blunt termination, suggestive of a sinusigerid-claw. Sinus very broad and shallow, occupying the shoulder slope. Outer lip thin; no parietal tubercle or callus pad. Adult sculpture of flat-topped spiral cords, beaded at the peripheral angle by numerous short oblique axials, and typically, with a second angulation of the body-whorl, proceeding from the suture and defined by a heavier smooth spiral cord. The genus is apparently close to *Comitas* but the shell is of lighter build, has the axial sculpture restricted to the peripheral carina, there is a second smooth carina on the base, the sinus is wider and more shallow and the protoconch is sharply carinated throughout. Range — New Zealand, Recent and Pleistocene. Also recorded from the Miocene and Pliocene of Okinawa, but it is doubtful if there is true relationship.

#### CHARACTERISTIC SPECIES—

NEW ZEALAND; Recent, *augusta* (Murdoch & Suter, 1906); *gypsata* (Watson, 1881). Pleistocene, *castlecliffensis* (Marshall & Murdoch, 1919); *gemmea* (Murdoch, 1900); *protransenna* (Marshall & Murdoch, 1923). OKINAWA, Miocene-Pliocene, *rodgersi* Mac Neil, 1960.

#### Genus ANTIMELATOMA Powell, 1942,

Bull. no. 2, Auck. Inst. Mus., p. 97. Type (o.d.) *Drillia maorum* Smith, 1877.

##### Plate 2, figs. 2, 3

Shell small to moderate sized, 14 - 18 mm., narrowly fusiform, with a tall spire and a moderately long unnotched slightly flexed anterior canal. Sinus broad, retracted to a rather narrowly U-shaped apex, which is just below the middle of the shoulder slope. Protoconch blunt, paucispiral, of slightly more than two whorls; first smooth, dome-shaped, second with four spiral cords. Outer lip thin; inner lip without a parietal tubercle or callus pad. Adult sculpture of prominent fold-like axials, restricted to the peripheral area, and rather strong spiral cords, that override the axials. Operculum leaf-shaped, with a terminal nucleus. Radula (text fig. B38) of modified wish-bone-type, consisting of a pair of marginals, in which one of the basal limbs is severed. The result is a large elongated elliptical tooth, partially overlaid by a slightly shorter but much more slender member (*ahiparana*). The genus is somewhat of clavinid facies, except



for the style of sinus and absence of a parietal tubercle, but its true relationship seems to be with the turriculinids, near to *Comitas*. Range — New Zealand, Recent and Pleistocene.

CHARACTERISTIC SPECIES—

Recent, *ahiparana* Powell, 1942; *benthicola* Powell, 1942; *buchanani* subsp. *maorum* (Smith, 1877); *canyonensis* Dell, 1956. Pleistocene, *buchanani* (Hutton, 1873).

Genus NIHONIA Mac Neil, 1960,

U.S. Geol. Surv. Prof. Paper 339, p. 105. Type (o.d.) *Nihonia shimajiriensis* Mac Neil, 1960. Syn. *Fusosurcula* (Kuroda ms.) (nom. nud.) in Taki, 1951, Handbook Illust. Shells (Japan), pl. 115, fig. 12, for *Pleurotoma* (*Surcula*) *mirabilis* Sowerby, 1914.

Plate 2, figs. 4, 5

Shell large, up to 100 mm., elongate fusiform, with a tall spire and a long straight unnotched anterior canal. Protoconch small, of  $1\frac{1}{2}$  to 2 whorls, smooth, the tip loosely coiled and inrolled, terminated by sigmoid brephic axials, a few in *mirabilis*, almost a whorl of closely spaced axials in *australis*. Adult sculpture of prominent smooth spiral keels and cords, gemmate in the Miocene *sucabumiana*. Sinus deeply U-shaped, situated on the shoulder slope. Outer lip produced forward in a great swinging arc, which gives an appearance of considerable depth to the sinus. Operculum leaf-shaped, with a terminal nucleus. Colour pattern of reddish-brown axial flames (*mirabilis* and *circumstricta*) or orange-buff, with the primary spirals darker (*australis*). Range — Oligocene?: Burma. Miocene: Okinawa (type) and Java. Pliocene: Sumatra. Recent: Indo-Pacific; East Africa to Japan.

CHARACTERISTIC SPECIES—

Oligocene: *birmanica* (Vredenburg, 1921). Miocene: *shimajiriensis* Mac Neil, 1960; *sucabumiana* (Martin, 1895). Pliocene: *sucabumiana* (Martin, 1895); *pervirgo* (Yokoyama, 1928); *soyomaruue takanabensis* (Otuka, 1959). Recent: *australis* (Roissy, 1805); *circumstricta* (Martens, 1901); *mirabilis* (Sowerby, 1914); *soyomaruue* (Otuka, 1959).

Genus LEUCOSYRINX Dall, 1889,

Bull. Mus. Comp. Zool. 18, no. 29 (2), p. 75. Type (o.d.) *Pleurotoma verrilli* Dall, 1881.

Plate 2, figs. 6-9

Shell moderate to large sized, up to 73 mm., of light build, elongate-fusiform, with a tall turreted or pagodiform spire, and a long straight or slightly flexed, unnotched anterior canal. Protoconch small, globular, of  $1\frac{1}{2}$  - 2 smooth whorls. Adult sculpture usually of axial nodes on the peripheral angle and plain spiral cords or threads on the lower part of the whorls. Sinus moderately deep, occupying the whole of the shoulder slope, its apex being broadly shallowly concave. There is no subsutural marginal fold, so the sinus commences at the suture. Below, the sinus is confluent with a

considerable forward arcuate projection of the outer lip, which accentuates the appearance of depth to the sinus. Most species are devoid of colour pattern, but occasionally axially flamed in reddish-brown; usually there is a thin pale periostracum. Operculum ovate to leaf-shaped, with a terminal nucleus. Radula (*verrilli*; text fig. B12), a pair of marginals of modified wishbone-type, one of the two basal limbs separated and superimposed upon the larger element of the tooth, which tapers to a simple point. Range — Recent in the deep ocean basins of the southern United States, Caribbean, South Atlantic, Indo-Pacific and Antarctica. Also Eastern Pacific, Northern Australia and New Zealand; Miocene or Pliocene of Okinawa.

CHARACTERISTIC SPECIES—

Recent—S.E. UNITED STATES and CARIBBEAN — *sigsbeeii* (Dall, 1881); *subgrundifera* (Dall, 1888); *tenoceras* Dall, 1889; *verrilli* (Dall, 1881). S. ATLANTIC; *falklandica* and *paragenota* Powell, 1951. INDO-PACIFIC; *caecilia*, *elsa*, *erna*, *julia*, *sansibarica* and *suratensis* Thiele, 1925. QUEENSLAND; *n.sp.* Powell, (ms). NEW ZEALAND; *piki* (Dell, 1963). ANTARCTICA; *macrobertsoni* and *mawsoni* Powell, 1958. Miocene or Pliocene; OKINAWA; *iwaensis* Mac Neil, 1960.

Genus VEXITOMINA Powell, 1942,

Bull. no. 2, Auck. Inst. Mus., p. 77. Type (o.d.) *Drillia metcalfei* Angas, 1867.

Plate 2, figs 10, 11

Shell of moderate size, 15 - 33 mm., claviform, with a tall spire and truncated anterior end, but without a definite parietal tubercle, except for a thickened callus in a gerontic state. Protoconch of  $2\frac{1}{2}$  smooth whorls, usually developing a weak low-set keel towards its termination, which is defined by a forwardly projected weak axial growth line, followed by numerous weak axials, gradually increasing in strength along the spiral keel as the post-nuclear sculpture develops. Sinus rather shallow, with a broadly rounded apex, occupying the middle of the shoulder slope, not subtubular, constricted or ridge-margined. Adult sculpture of axials crossed by spirals in varying strengths, usually developed into peripheral nodes or pointed tubercles, in single or double series. Outer lip not variced; anterior canal very short and shallowly notched. Operculum leaf-shaped, with a terminal nucleus. Range — Recent, New South Wales, Victoria, Tasmania, northern New Zealand and Indo-Pacific, Mauritius, East Indies, Philippines and Loyalty Islands.

CHARACTERISTIC SPECIES—

AUSTRALIA, *coriorudis* (Hedley, 1922); *coxi* (Angas, 1867); *garrardi* Laseyron, 1954; *metcalfei* Angas, 1867); *pilazona* Laseyron, 1954; *suavis* (Smith, 1888) (= *prosuavis* Hedley, 1903); *torquata* Laseyron, 1954. NEW ZEALAND, *optabilis* (Murdoch & Suter, 1906) INDO-PACIFIC, *regia* (Reeve, 1842) (= *rougeyroni* Souverbie, 1894).

## Genus KNEFASTIA Dall, 1919,

Proc. U.S. Nat. Mus. 56 no. 2288, p. 3. Type (o.d.) *Pleurotoma olivacea* Sowerby, 1834.

## Plate 2, fig. 12

Shell large, robust, 50 - 70 mm., biconic-fusiform, with a tall turreted spire and a moderately long, straight to slightly recurved anterior canal. Resembling *Clavatula* in the coarseness of the sculpture and especially in the moderately high clasping adpressed suture, but the operculum is leaf-shaped with a terminal nucleus, not clavatulid, that is with the nucleus medio-lateral. Adult sculpture of broadly rounded to angular prominent axials overridden by coarse spiral cords. Typically the shell is covered by a thick periostracum. Sinus deep, U-shaped, occupying the middle of the shoulder slope. Radula (text figs. B8, 9) with a minute unicuspid vestigial central tooth and a pair of modified "wishbone-type" marginals, in which the distal limb of the base is severed from the rest of the tooth. *Knefastia* resembles *Clavatula* in its adpressed suture but lacks the heavy nodose subsutural fold of that genus. Also the operculum is more in accord with that of the turriculid genus *Comitas*. Range — Recent, Gulf of California to Ecuador. Miocene to Oligocene, Washington, Costa Rica, Panama, West Colombia, Peru, Florida and Dominican Republic. (Also recorded from the Miocene of France and Angola, and the Pliocene of Italy, but these claims require substantiation).

## CHARACTERISTIC SPECIES—

Recent—*dalli* (Bartsch, 1944); *funiculata* (Kiener, 1839-40); *olivacea* (Sowerby, 1834); *nigricans* Dall, 1919; *princeps* Berry, 1953; *tuberculifera* (Broderip & Sowerby, 1829); *walkeri* Berry, 1958. Miocene—*glypta* Gardner, 1937; *jaquensis* (Sowerby, 1850); *lavinooides* Olsson, 1922 and subsp. *limonensis* Olsson, 1922; *waltonia* Gardner, 1937. Oligocene—*brooksvillensis* Mansfield, 1937; *chira* Olsson, 1931; *rossellae* Durham, 1944.

## Genus FUSITURRICULA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 165. Type (o.d.) *Turris* (*Surcula*) *fusinella* Dall, 1908.

## Plate 2, fig. 13

Shell small to medium sized, up to 30 mm., narrowly fusiform, of light build, *Fusinus*-like. Protoconch narrowly conic, of  $1\frac{3}{4}$  to  $2\frac{3}{4}$  smooth whorls with a small erect nucleus. Adult sculpture of stout fold-like oblique axials, overridden by spiral threads and cords; some, including the type species, with a low-set peripheral biangulation. Sinus wide, moderately deep, adjoining the suture and confluent below with a great arcuate forwardly projected expansion of the outer lip, which gives the impression of great depth to the sinus. Anterior canal moderately long and straight, unemarginate at its extremity. Radula of marginals only, wishbone-type, but long and narrow. Range — Recent

from Panama and West Mexico and Miocene in the Caribbean.

The chief differentiating character distinguishing *Fusiturricula* is the impression of a very deep anal sinus resultant from the greatly forwardly produced outer lip. The genus seems to be very closely allied to the Eocene-Miocene *Pleurofusia* the type species of which is from the Claibornian Eocene of Alabama.

## CHARACTERISTIC SPECIES—

Recent, *armilda*, *dolenta* and *fusinella* (Dall, 1908); *enae* Bartsch, 1934; *howelli* Hertlein & Strong, 1951. Miocene, *humerosa* (Gabb, 1873); *iole* and *panola* Woodring, 1928.

Subgenus CRENATURRICULA Vokes, 1939 (of *Fusiturricula*),

Ann. New York Acad. Sci. 38 p. 114. Type (o.d.) *Surcula crenatospira* Cooper, 1894.

## Plate 2, fig. 14

This was proposed as a subgenus of *Fusiturricula* for a Californian fossil from the Capay horizon of the Eocene, and with it was associated *Pleurotoma dentata* Lamarck, 1804, of the Lutetian Eocene of the Parisian Basin, possibly *Pleurotoma michelini* Deshayes, 1865, also of the Paris Basin and *Pleurotoma keelei* Edwards, 1856 of the English Eocene. The following European Paleocene and Eocene species were referred to the subgenus by Glibert (1960, Mem. Inst. Roy. Sci. Nat. de Belgique, ser. 2, 64, pp. 33-35) — *bouryi* Glibert, 1960; *brevicauda* (Deshayes, 1834); *crassicosta* Edwards, 1856; *dentata* (Lamarck, 1804); *exorta* (Solander, 1766); *hauniensis* (Koenen, 1885); *macilenta* (Solander, 1766); *michelini* (Deshayes, 1865); *polycesta* (Bayan, 1873) and *textiliosa* (Deshayes, 1834). Vokes remarked that "The Eocene species which appear to be referable to *Fusiturricula* are in general larger and stouter than in the later species of this genus, the anal sinus somewhat shallower and the outer lip does not project as far forward."

Subgenus FUSISYRINX Bartsch, 1934 (of *Fusiturricula*).

Smithsonian Misc. Coll. 91 (2), p. 7. Type (o.d.) *Fusisyrinx fenimorei* Bartsch, 1934.

## Plate 2, fig. 17

Shell large, 56 mm., *Fusinus*-like, probably close to, if not identical with *Fusiturricula*. Spire tall, turreted, and body-whorl tapered to a very long, straight, unemarginate anterior canal. Protoconch unknown. Adult whorls sharply medially carinate and sculptured with short oblique rounded axials, crossed from the periphery downward by moderate closely spaced spiral cords. Sinus deep, broadly rounded at its apex, the lower margin projected forward, confluent with an arcuate sweep of the outer lip. In Bartsch's figured



holotype the lower edge of the sinus is shown to descend steeply, leaving the sinus widely open, but this is the result of shell damage, for a paratype shows the normal condition of the sinus, the sides of which are subparallel. Except for the unknown factor, the protoconch, there seems to be little to separate *Fusisyrinx* from *Fusiturricula* other than larger size and a slightly longer and straighter anterior canal for the former. Until more is known concerning *Fusisyrinx* it is retained tentatively as a subgenus of *Fusiturricula*. Range — known only by the type species from 80-180 fathoms in the Puerto Rico Deep.

Genus CRUZITURRICULA Marks, 1951,  
Bull. Amer. Paleont., Ithaca, 33 (139), p. 131. Type (o.d.) *Turricula* (*Pleurofusua*) *cruziana* Olsson, 1932.

Plate 2, fig. 15

The author of this genus stated that it is most closely related to *Fusiturricula*, from which it differs mainly in having a more attenuated protoconch, and in the form of the anal sinus. *Cruziturricula* has a mesocostate, unicarinate early spire sculpture, while *Fusiturricula* is bicarinate; *Cruziturricula* has irregular axial ribs, while those of *Fusiturricula* are regular and evenly spaced. The anal sinus in *Fusiturricula* is deep, with a vertical angle with the suture; that of *Cruziturricula* is a deep slot, the upper edge being a retrocurrent oblique line against the suture. Range — lower and upper Eocene of Peru, Miocene of Peru and Ecuador, Pliocene of Panama and Costa Rica and Recent, tropical West America.

CHARACTERISTIC SPECIES—

Eocene, *eolavinia* (Olsson, 1930); *piura* (Olsson, 1931). Miocene, *cruziana* (Olsson, 1932). Pliocene, *andesita* (Olsson, 1942). Recent, *arcuata* (Reeve, 1843); *lavinia* (Dall, 1919).

Genus MEGASURCULA Casey, 1904,  
Trans. Acad. Sci. St. Louis 14, p. 147. Type (s.d. Grant & Gale, 1931) *Pleurotoma* (*Surcula*) *carpenteriana* Gabb, 1865.

Plate 2, fig. 18

Shell large, up to 100 mm., biconic-ovate, with a moderately tall spire and a long capacious body-whorl, slowly tapered to an almost undifferentiated short but deeply notched anterior canal, with a ridge-margined fasciole. Protoconch small of two smooth rounded whorls. Anal sinus broad and shallow, occupying most of the broad steeply descending shoulder slope. Operculum leaf-shaped with a terminal nucleus. Radula (text figs. 10, 11), a pair of modified "wishbone"-shaped marginals, in which the distal limb of the base is detached. Colour of the type species is buff to orange-brown, irregularly spirally lined in dark reddish-brown. Range — Recent, California, in deep water, Pliocene and Miocene of California and

Washington and Miocene of Ecuador, Japan and Korea.

CHARACTERISTIC SPECIES—

Recent—CALIFORNIA; *carpenteriana* (Gabb, 1865) and subsp. *tryoniana* (Gabb, 1866); *granti* Bartsch, 1944; *remondii* (Gabb, 1866); *tremperianus* (Dall, 1911). Pliocene — CALIFORNIA; *fernandoana* (Arnold, 1907); *riversiana* (Raymond, 1904). Miocene — CALIFORNIA and WASHINGTON; *etheringtoni* Weaver, 1942; *howei* Hanna & Hertlein, 1938; *keepi* (Arnold, 1907); ECUADOR; *guaya-sensis* Marks, 1951, JAPAN and KOREA; *crypto-conoides* (Makiyama, 1926); *osawanoensis* (Tsuda, 1959); *rara* (Nomura & Onisi, 1940); *siogamensis* (Nomura, 1935); *yokoyamai* (Otuka, 1934).

Genus RHODOPETOMA Bartsch, 1944,  
Proc. Biol. Soc. Wash. 57, p. 59. Type (o.d.) *Borsonella rhodope* Dall, 1919.

Plate 2, fig. 16

Shell of medium size, 19-22 mm., very similar in appearance to *Borsonella* but without a pillar plait. Nuclear whorls eroded in all known examples. Spire tall; body-whorl short, excavated to a moderate neck and ending in a relatively short, flexed, unnotched anterior canal. Adult sculpture consisting of a moderate, rounded subsutural fold, a shallow shoulder sulcus, followed by a broadly rounded peripheral bulge, which occupies the lower half of the spire whorls. Surface crossed by weak and irregular obliquely protractive flexuous axial folds, best developed over the peripheral area, overridden by fine threads on the anal fasciole, and from the shoulder downward by spiral lirae. A moderately thick periostracum covers the entire shell. Aperture obliquely pyriform. Outer lip thin with a deep broadly rounded subsutural sinus, after which the lip is arcuately forwardly produced. Inner lip a spreading smooth callus, without plicae. Operculum lanceolate, with a terminal nucleus. Radula (text fig. B13) consisting of a vestigial central tooth, and long narrow marginals of wishbone-type, each with the distal basal limb severed.

The radula in *Borsonella* (*barbarensis*, *callicesta*, *coronadoi* and *nicoli*, all of Dall) consists of long relatively straight to flexed narrow simple pointed marginals, with a slightly expanded base. Upon the radula evidence therefore, *Rhodopetoma* is more likely a member of the Turriculinae than of the Borsoniinae. Range — California, in deep water, off Santa Rosa Island, 82 fathoms and off Monterey in 581 fathoms. Two species, *Pleurotoma* (*Clavatulula*) *erosa* Schrenck, 1867, and *Rhodopetoma akkeshiensis* Habe, 1958 (Publ. Akkeshi Mar. Biol. Stat. no. 8, p. 32), claimed to represent *Rhodopetoma* in Japanese waters, do not appear to be related to the Californian members.

CHARACTERISTIC SPECIES—

*amycus* and *rhodope* (Dall, 1919).



Genus *HORMOSPIRA* Berry, 1958,  
Leaflets in Malacology, Redlands, Calif. 1 (15),  
p. 90. Type (o.d.) *Pleurotoma maculosa* Sowerby,  
1834.

Plate 2, figs. 19, 20

Shell moderately large, 37 - 40 mm.,  
*Turricula*-like, elongate-fusiform, with a tall  
and narrow turreted spire, and a narrow body-  
whorl, gradually tapered to a moderately long,  
almost straight, broadly and weakly notched  
anterior canal. Protoconch small, broadly conical  
of about three whorls. Adult sculpture of  
bluntly rounded tubercles on a rather prominent  
peripheral angulation, at below middle  
whorl height. Suture submargined by a broad  
but inconspicuous fold; shoulder sulcus smooth;  
closely spaced weak spiral lirae from the periphery  
to the anterior end. Sinus moderately  
deep, a broadly open V, but narrowly rounded  
at its apex, which is on the lower half of the  
shoulder slope. The thin edged outer lip swings  
forward from the lower edge of the sinus, but  
contracts below to a broadly indented strom-  
boid notch. Colour dull white, conspicuously  
but irregularly maculated in reddish-brown,  
under a pale brownish periostracum. Oper-  
culum leaf-shaped with a terminal nucleus.  
Radula (text figs. B30, 31) unlike that of any  
other known turrid except that of *Pseudomela-*  
*toma*, consisting of a large rectangularly based  
unicuspid central tooth and a pair of massive  
simple slender pointed marginals. The radula  
has a superficial resemblance to that of the  
muricids. Range — Gulf of California to  
Ecuador, 0-66 fathoms.

The systematic position of both *Hormospira*  
and *Pseudomelatoma* can be settled only upon  
anatomical grounds, but I do not have the  
necessary material. For the present they are  
tentatively placed in the *Turriculinae*.

CHARACTERISTIC SPECIES—

*libya* (Dall, 1919), *maculosa* (Sowerby, 1834).

Genus *TIARITURRIS* Berry, 1958,  
Leaflets in Malacology, Redlands, Calif. 1 (15),  
p. 87. Type (monotypy) *Tiariturris spectabilis*  
Berry, 1958.

Plate 2, fig. 22

Shell large, 62.6 mm., narrowly fusiform,  
with a tall coronated spire and a narrow body-  
whorl, gradually tapered to a moderately long,  
straight, unnotched anterior canal. Protoconch  
incompletely known, apex missing but follow-  
ing whorls strongly axially costate. Adult sculp-  
ture of coronated peripheral tubercles, confined  
to the high shoulder angle. Spiral sculpture  
weak, confined to the early spire whorls, then  
becoming obsolete. Aperture narrow, less than  
half the height of the shell; outer lip thin, with  
a wide but moderately deep sinus, occupying  
the shoulder slope. Colour creamy white with  
spots and axial streaks of reddish-brown.

The genus recalls *Knefastia* but there may  
not be close relationship. Range — Known

only by the type species, from off the Isla  
Angel de la Guarda, Baja California in 67  
fathoms.

Genus *PSEUDOMELATOMA* Dall, 1918,  
Proc. U.S. Nat. Mus. 54, p. 317. Type (o.d.)  
*Drillia penicillata* Carpenter, 1865.

Pl. 3, fig. 1

Shell of medium size, up to 45 mm., clavi-  
form, elongate-fusiform, with a tall spire of  
lightly convex whorls, and a long narrow  
body-whorl, gradually tapered to a short,  
broadly and shallowly notched anterior canal.  
Protoconch small, conical, apparently of sev-  
eral smooth whorls. Adult sculpture consisting  
firstly of a moderate subsutural fold, set with  
weak bluntly rounded nodes, followed by a  
shallowly concave smooth sinus area; then  
from the weakly defined broadly rounded peri-  
phery downward is a series of moderately  
strong, slightly oblique, fold-like axial ribs.  
Sinus similar to that of *Hormospira*, a broadly  
open V, narrowly rounded at its apex, which  
is on the lower half of the shoulder slope.  
Outer lip thin, stromboid notch obsolete.  
Colour dark brown, often with a dense pattern  
of zigzag lines in darker brown, the whole  
covered by a brownish periostracum. Oper-  
culum leaf-shaped with a terminal nucleus.  
Radula (text figs B27-29) very similar to that  
of *Hormospira*, consisting of a large rectangu-  
lar based unicuspid central tooth and a pair of  
massive marginals, gradually tapered to a  
simple sharp point. Range — Oligocene to  
Recent, California and Lower California.

CHARACTERISTIC SPECIES—

Recent — *grippi* (Dall, 1919), *moesta* (Carpenter,  
1864), *penicillata* (Carpenter, 1865), *sticta* Berry,  
1956, *torosa* (Carpenter, 1863) and subsp. *aurantia*  
(Carpenter, 1863). Pleistocene-*penicillata* subsp.  
*seminflata* Grant & Gale, 1931, *somisensis* Waterfall,  
1929. Pliocene-*fleenerensis* (Martin, 1914). Oligo-  
cene-*fulleri* Durham, 1944.

Subgenus *LAEVITECTUM* Dall, 1919 (of  
*Pseudomelatoma*),

Proc. U.S. Nat. Mus. 56, no. 2288, p. 19. Type  
(o.d.) *Drillia eburnea* Carpenter, 1865.

Plate 2, fig. 21

Shell of moderate size, 30 mm., claviform,  
smooth and featureless, except for axials on  
one or two of the earliest whorls of the  
spire. The type of the genus is apparently the  
only known specimen. The protoconch is mis-  
sing, and the lightly convex whorls have a  
smooth worn appearance of pinkish-white  
colour. The body-whorl is narrow, gradually  
tapered to a short apparently unnotched anter-  
ior canal, and the subsutural sinus is very  
slight.

The species was described as a *Drillia*, made  
the type of *Laevitectum*, as a subgenus of  
*Clathrodrillia* by Dall (l.c.), and its present  
resting place is as a subgenus of *Pseudomela-*



*toma*; see Grant & Gale, 1931 (Mem. San Diego Soc. Nat. Hist. 1, p. 564) and Keen, 1958 (Sea Shells of Tropical West America, p. 478).

If this latter allocation proves to be the correct one, then *Laevitectum* differs from *Pseudomelatoma* only in having the sculpture almost obsolete, and in having a much weaker anal sinus. Range — The type species is from the Gulf of California.

Genus AUSTROCARINA Laseron, 1954, Handb. Roy. Zool. Soc. N.S.W. p. 22. Type (o.d.) *Leucosyrinx recta* Hedley, 1903.

Plate 3, fig. 2

Shell small, 6 mm., thin, tall and narrow, with a pagodiform spire and a truncated body-whorl, terminated in a short flexed, unnotched anterior canal. Protoconch exsert, smooth, of two whorls. Adult sculpture of two sharp keels, one just above middle whorl height on the spire, the other emergent at the lower suture. Surface spirally lirate, crossed by fine axial growth lines. Sinus very slight, just a shallow concavity, occupying all of the shoulder slope. Laseron (1954) assigned his genus temporarily to the Borsoniinae but there is no trace of pillar plaits, so the Turriculinae is preferred, but again as a temporary measure. Range — known only by the type species, which is from New South Wales, Victoria and Tasmania in 40-80 fathoms.

Genus BATHYBELA Kobelt, 1905, Iconogr. Schalent. Europ. Meeresconch. 3, p. 275. Type (s.d. Dall, 1918) *Thesbia nudator* Locard, 1897.

Plate 3, fig. 3

Shell rather large, 24 - 40 mm., thin and fragile, pale yellowish, ovate-fusiform, with a tall attenuated spire of tabulated whorls and a large rotund, weakly angulated, capacious body-whorl, much constricted over the neck, and terminated in a very short unnotched anterior canal. Aperture broadly ovate. Outer lip thin with a broadly arcuate shallow sinus, occupying most of the shoulder slope. Adult sculpture of numerous weak spiral lirations and even less conspicuous thin axials. The inner lip is smooth callused, apparently without plications. Range — off the Azores and Morocco in 1200 to 4000 metres.

CHARACTERISTIC SPECIES—  
*folini* and *nudator* Locard, 1897.

Genus BELATURRICULA Powell, 1951, Discovery Reports, vol. 26, p. 170. Type (o.d.) *Bela turrita* Strebel, 1908.

Plate 3, fig. 5

Shell rather large, 50mm., fusiform, with a tall spire and a narrowly ovate body-whorl, terminated in a short spout-like unnotched anterior canal. Protoconch large, bluntly

rounded, paucispiral and smooth. Sinus turriculid style but very shallow. Outer lip very little produced, its edge parallel in profile to the axis of the shell. Post-nuclear whorls without sculpture, other than faint spiral striae. Operculum and radula unknown. Range — off South Georgia, off South Africa and south east of the Philippines, 80-900 fathoms.

CHARACTERISTIC SPECIES—

*turrita* (Strebel, 1908) (South Georgia) and *dissimilis* (Watson, 1886) (?South Africa and the Philippines).

Genus BELOMITRA P. Fischer, 1882,

Journ. de Conchyl. 30, p. 275. Type (monotypy) *Belomitra paradoxa* P. Fischer, 1882. Syn. *Pleurobela* (Monterosato ms.) Locard, 1897, Expéd. Scient. Trav. Talisman, 1, pp. 263-264. Type (o.d.) *Pleurobela spelta* (Monterosato ms.) Locard, 1897. = *Pleurobela* Kobelt, 1905, Icon. Schalent. europ. Meeresconchyl. 4, p. 301 (for two species from Monterosato ms. — *spelta* and *lyrata* = *spelta* and *lyrata* Locard, 1897).

Plate 3, fig. 4

Unfortunately the type species of *Belomitra* is unfigured, but its description tallies with that of *fischeri*, another species associated with the genus by both Locard and Kobelt.

These shells are moderately large, 16-22 mm., thin-shelled, narrowly bucciniform, with a paucispiral mamillate protoconch. Spire tall with narrow whorls, distinctly angulate above the middle, and with a long narrow body-whorl, gradually tapered to an undifferentiated spout-like anterior canal. Aperture narrowly ovate. Outer lip thin-edged, without an apparent sinus. Inner lip described as having several weak plaits but these must be well within the aperture, for they do not show in the illustrations. Adult sculpture of rather numerous narrow axials, continuous from suture to suture and over most of the base, overridden by weaker spiral lirae, one or two stronger ones, sometimes beaded, submargining the suture.

The systematic position of the genus is conjectural, and it may not be turrid. Range — North Atlantic, from off Portugal to the Azores in 600 to 2200 metres.

CHARACTERISTIC SPECIES—

*delicatulina*, *fischeri*, *lyrata* and *spelta* (Locard, 1897) and *paradoxa* Fischer, 1882.

Genus CLAVOSURCULA Schepman, 1913, Siboga Exped. Monog. 49, 1e, p. 429. Type (o.d.) *Clavosurcula sibogae* Schepman, 1913.

Plate 3, figs. 6, 7

Shell of moderate size, 38 mm., thin-shelled, pyriform, with a broadly conical rather flat-sided spire, a sharp peripheral angle and a rapidly tapered base to a long straight unnotched anterior canal. Protoconch small, globose, of 1½ smooth whorls. Sinus wide and moderately deep, occupying most of the shoulder slope. Adult sculpture of spiral lirae, fine on the spire, coarser on the keel and much stronger on the base. Range — Known only by

the type species from 794 metres in the Flores Sea.

Genus *TYPHLOSyrinx* Thiele, 1925,

Gast. Deutsch. Tiefsee-Exped. 17 (2), p. 218. Type (o.d.) *Pleurotoma (Leucosyrinx) vepallida* Martens, 1902.

Plate 3, fig. 8

Shell large, 32-47 mm., tall narrow spired, with low-set peripheral nodes, obsolete from the lower whorls, and an ovate body-whorl, truncated to a short straight anterior canal, with an unnotched spout-like termination, Protoconch paucispiral, globose and smooth. Sinus broad, concavely arcuate, of moderate depth, occupying most of the ill-defined shoulder slope, thence confluent with a broadly arcuate swing of the outer lip, resulting in a sigmoid profile for the whole of the thin edged lip. Operculum absent, and radula toxoglossate, a pair of slender marginals, barbed at the tip (Thiele). The subfamily location of the genus is a little uncertain. The absence of an operculum and the type of radula suggest the Daphnellinae, but on the other hand the smooth paucispiral protoconch and turriculid style of sinus favour reference to the Turriculinae. Range — Gulf of Aden to the Flores Sea in deep water, 300 - 900 fathoms.

CHARACTERISTIC SPECIES—

*praecipua* (E. A. Smith, 1899); *supracostata* (Schepman, 1913); *vepallida* (Martens, 1902).

Genus *AMULETUM* Stephenson, 1941,

Texas Univ. Bull. 4101, p. 369. Type (o.d.) *Turricula macnairiensis* Wade, 1926.

Plate 3, figs. 9, 10

Shell small, 10-15 mm., elongate-fusiform, very slender with a tall spire and long slender slightly flexed unnotched anterior canal. Protoconch large of 3-4 narrowly conical smooth whorls. Adult whorls rounded, slightly constricted on the shoulder slope and with a moderate subsutural fold. Adult sculpture of numerous spiral cords crossed by closely spaced long flexuous narrow axials which commence at the suture, cross the shoulder slope, very little diminished, regaining strength over the peripheral area and then gradually fading out over the base. There is a shallow subsutural sinus. The genus differs from *Turricula* in its very slender shape and narrowly conical smooth 3-4 whorled protoconch. Range — late Cretaceous of the southern United States.

CHARACTERISTIC SPECIES—

*dumasensis* Sohl, 1964; *fasciolatum* (Wade, 1926); *macnairiensis* (Wade, 1926) (= *curvocostatum* Stephenson, 1941 = *ripleyana* Wade, 1926) and subsp. *torquatum* Sohl, 1964; *wadei* Harbison, 1945.

Subgenus *LUTEMA* Stephenson, 1941 (of *Amuletum*),

Texas Univ. Bull. 4101, p. 373 Type (o.d.) *Lutema simpsonensis* Stephenson, 1941.

Plate 3, fig. 11

Shell of moderate size, up to 30 mm., similar to *Amuletum* but with stronger shouldering and peripheral nodulation. Range — Ripley Formation of Texas and Mississippi.

CHARACTERISTIC SPECIES—

*geniculata* Stephenson, 1941; *hubbardi* Stephenson, 1941; *limbatum* Sohl, 1964; *munda* Stephenson, 1941 and *simpsonensis* Stephenson, 1941.

Genus *BERETRA* Stephenson, 1941.

Texas Univ. Bull. 4101, p. 373. Type (o.d.) *Beretra firma* Stephenson, 1941.

Plate 3, figs. 15, 16

Shell of moderate size, 50-60 mm., elongate fusiform, very slender, with a tall spire and long straight unnotched anterior canal. Adult whorls strongly sculptured with closely spaced long rounded vertical axials, crossed by closely spaced spiral cords which are strongest in the axial interspaces. Sinus subsutural, distinctly notched. Aperture long and narrow. A feature of the genus is the heavy subsutural margining cord, which is rendered strongly nodose by the axials. The genus resembles *Amuletum* but has stronger axial sculpture and the addition of a prominent nodose subsutural fold. Range — Late Cretaceous of the Atlantic and Gulf coastal plains from Maryland to Texas.

CHARACTERISTIC SPECIES—

*amica* (Gardner, 1916); *contracta* Stephenson, 1941; *elongata* Stephenson, 1941; *firma* Stephenson, 1941; *gracilis* (Wade, 1926); *ornatula* Stephenson, 1941; *ripleyana* (Conrad, 1858) (= *georgiana* Gabb, 1876 = *striata* Stephenson, 1941) and *speciosa* Sohl, 1964.

Genus *REMNITA* Stephenson, 1941,

Texas Univ. Bull. 4101, p. 378. Type (o.d.) *Turricula biacuminata* Wade, 1926.

Plate 3, figs. 12, 13

Shell of medium size, 28-50 mm., elongate fusiform, very slender, with a tall spire and narrow body-whorl, gradually tapered to a long straight unnotched anterior canal. Protoconch proportionately large, narrowly conical of 3-4 smooth regular whorls. Subsutural margining very narrow. Sculpture initiated, and dominated throughout by spiral cords. Range — Late Cretaceous of Mississippi and Texas, confined to the "*Exogyra costata* zone".

CHARACTERISTIC SPECIES—

*biacuminata* (Wade, 1926); *anomalocostata* (Wade, 1926) and *hastata* Sohl, 1964.

Genus *FUSIMILIS* Stephenson, 1941.

Texas Univ. Bull. 4101, p. 378. Type (o.d.) *Fusimilis robustus* Stephenson, 1941.

Plate 3, fig. 14

Shell moderately large, 60-88 mm., fusiform with a tall turreted spire and long straight unnotched anterior canal. Similar to *Beretra* but with an ovate less elongate aperture and a sinus in a lower position, coinciding with the shoulder angulation. The sculpture is of strong



vertical long axial ribs, suddenly terminated at the shoulder, which defines a relatively deep and narrow shoulder sulcus. Subsutural fold moderate, bearing numerous axial growth folds. Range — Late Cretaceous, Ripley, Owl Creek and Monmouth formations, Atlantic and Gulf areas from Maryland to Texas. Also upper Cretaceous of West Africa.

CHARACTERISTIC SPECIES—

UNITED STATES—*kummeli* Sohl, 1964; *mon-mouthensis* (Gardner, 1916); *novemcostata* (Conrad, 1858); *proxima* (Wade, 1926) (= *constricta* Wade, 1926). WEST AFRICA—*aurilotalis* Cox, 1952.

Genus SCALATURRIS Brebion, 1954,

Bull. Mus. Nat. D'Hist. Nat., Paris, 2, 25, 6, p. 645. Type (o.d.) *Scalaturris riedeli* Brebion, 1954.

Plate 3, fig. 24

Shell moderately large, 49 mm. Known to me only by the author's original description and very sketchy line figure. The type specimen is evidently minus both the apical whorls and the extremity of the anterior canal, as well as being somewhat distorted. Spire broadly conical. Whorls with a coarsely crenulated or gemmate subsutural fold, followed by a narrowly concave shoulder slope, then angulated at about three fourths whorl height. From the angulation to almost the lower suture, but not below it, there are numerous strong almost vertical axials. The body-whorl is long and narrow, slowly tapered to an apparently long and straight anterior canal. Sinus very large, but not very deep, situated almost at the periphery. Range — Known only by the type species which is from the Senonian Cretaceous of the Cameroons, West Africa.

Brebion compared *Scalaturris* with the American Cretaceous turriculid genus *Fusimilis*. He also considered that *Turris kaffraria* Griesbach, 1871, from the Senonian of Pondoland, was related to *riedeli*, but Cox (1952, Gold Coast Geol. Surv. Bull. no. 17, p. 29) was of the opinion that Griesbach's species was non turrid (probably mitrid).

Genus APIOTOMA Cossmann, 1889,

Ann. Soc. Malac. Belgique 24, p. 263. Type (o.d.) *Pleurotoma pirulata* Deshayes, 1834.

Plate 3, fig. 23

Shell large, 18 - 63 mm., elongate-fusiform, with a tall spire and a long straight unnotched anterior canal. Protoconch smooth, globose to narrowly conic, of  $1\frac{1}{2}$  -  $2\frac{1}{2}$  whorls, with a small asymmetric tip. Spiral sculpture of weak to moderate threads or cords; axials mostly subobsolete or confined to the early spire whorls. Whorls weakly angulate above middle height. Shoulder slope slightly sunken. Sinus broadly arcuate but deep, occupying most of the shoulder slope. Range — Eocene of France (type) and India, Oligocene and Miocene of

Victoria, Miocene of Java and Recent from deep water off Borneo and the Philippines.

CHARACTERISTIC SPECIES—

Eocene—*pirulata* (Deshayes, 1834); *hypermece*s and *vredenburgi* (Cossmann & Pissarro, 1909). Oligocene—*bassi* Pritchard, 1904; *janjukiensis* (Chapple, 1934); *pritchardi* Powell, 1944. Miocene—*arntzenii* (Martin, 1914); *balcombensis* and *chapplei* Powell, 1944; *deningeri* (Martin, 1914); *granti* (Pritchard, 1904). Recent—*n.subspp.* Powell, (ms).

Genus ZEMACIES Finlay, 1926,

Trans. N.Z. Inst. 56, p. 252. Type (o.d.) *Zemacies elatior* Finlay, 1926.

Plate 3, fig. 18

Shell large, 24 - 100 mm., narrowly fusiform, with drawn out rapidly increasing whorls, tall turreted spire and long body-whorl, slowly tapered to a long straight unnotched anterior canal. Protoconch narrowly conical of 4-5 smooth glossy whorls. Adult sculpture of short axials to tubercles on a bluntly rounded peripheral angle, crossed by spiral threads or cords. Sinus very deep, on the shoulder slope; outer lip then produced far forward; a weak broad insinuation below, approximating to a stromboid notch. The genus resembles *Apiotoma*, but has the whorls more loosely coiled and rapidly increasing, as well as a more narrowly conical and polygyrate protoconch; that of *Apiotoma* is paucispiral and conoidal-mamilate. Range — Paleocene to lower Pliocene of New Zealand and Oligocene of Victoria, Australia.

CHARACTERISTIC SPECIES—

NEW ZEALAND; Paleocene—*immatura* Finlay & Marwick, 1937. Eocene—*armata* Powell, 1942; *gravidia* (Marshall, 1919); *hamiltoni* (Hutton, 1905); *marginalis* (Marshall, 1919) (= *equispiralis* Marshall, 1919= *hampdenensis* Marshall & Murdoch, 1920); *torticostata* (Marshall, 1919). Oligocene—*climacota* (Suter, 1917); *lividorupis* Laws, 1935; *ordinaria* (Marshall, 1918). Miocene—*awakinoensis* Powell, 1942; *elatior* Finlay, 1926; *simulacrum* Laws, 1935. Pliocene—*prendrevillei* Marwick, 1928. VICTORIA; Oligocene — *inexpectata* Powell, 1944.

Genus INSOLENTIA Finlay, 1926,

Trans. N.Z. Inst. 56, p. 252. Type (o.d.) *Pleurotoma pareoraensis* Suter, 1907.

Plate 3, fig. 19

Shell small to rather large, 6.5 - 60 mm., elongate-fusiform, with a tall turreted spire and a long almost straight unnotched anterior canal. Protoconch tall, narrowly conical, of 3 - 4 smooth whorls. Suture submargined by a broad flat rib. Sinus rather deep, rounded, on the shoulder slope. Adult sculpture predominantly axial; spiral sculpture of weak to moderate, closely spaced threads or cords. The genus resembles *Turricula* but has a much taller and narrowly conical protoconch. Range — Eocene to Miocene of New Zealand and Oligocene of Tasmania.

CHARACTERISTIC SPECIES—

NEW ZEALAND: Eocene — *laciniata* (Suter, 1917) (= *curialis* Marshall & Murdoch, 1920); *sertula*



(Suter, 1917); Oligocene — *elegantula* Powell, 1942; *pareoraensis* (Suter, 1907) (= *obliquecostata* Suter, 1917); Miocene — *famelica* Marwick, 1931; *inaequalis* Marwick, 1931; *seminuda* (Suter, 1917). TASMANIA: Oligocene — *johnstoni* (Tenison-Woods, 1877).

Genus THOLITOMA Finlay & Marwick, 1937, N.Z. Geol. Surv. Palaeont. Bull. no. 15, p. 85. Type (o.d.) *Tholitoma dolorosa* Finlay & Marwick, 1937.

Plate 3, fig. 22

Shell small, 14 mm., fusiform with a moderately tall turreted spire and a rather long flexed unnotched anterior canal. Protoconch dome-shaped of  $3\frac{1}{2}$  smooth rapidly increasing strongly convex whorls. Sinus turriculid, broadly U-shaped, moderately deep, occupying the lower part of a flat excavated shoulder slope, but clear of the peripheral angle. Adult sculpture of spiral cords, including one submarginating the suture and a stronger nodulose keel at the periphery; shoulder slope smooth. In general facies *Tholitoma* somewhat resembles *Eopleurotoma* but there is probably no close relationship. Range — The only known species is from the Paleocene of Wangaloa and Boulder Hill, New Zealand.

Genus CATENOTOMA Cossmann & Pissarro, 1900,

Faune Eocénique du Cotentin, Bull. Soc. Geol. de Normandie, 19 (1), p. 23. Type (monotypy) *Pleurotoma catenata* Lamarck, 1804.

Plate 3, fig. 17

Shell of moderate size, 25-30 mm., elongate-fusiform, with rather sagged whorls, sculptured with distant bold, broadly rounded axials, only 4-5 per whorl. The protoconch is paucispiral smooth and globose. Range — Known only by the type species which is from the Eocene of Cotentin, France.

Genus STENODRILLIA Korobkov, 1955,

Handb. and methodical Guide to the Tertiary Mollusca. Gastropoda. Leningrad (In Russian). Type (o.d.) *Drillia allionii* Bellardi, 1877.

Plate 3, fig. 21

Shell moderately large, 29 - 35 mm., fusiform with an attenuated spire and a moderately long slightly flexed anterior canal. Sculpture of rather distantly spaced broadly rounded axial folds which commence at a little above the peripheral angle and barely reach the lower suture. There is a relatively strong flat sub-sutural fold, bevelled at its lower edge, followed by a broad lightly concave shoulder slope, which is mostly devoid of spiral sculpture but exhibits numerous axial growth lines, defining successive positions of the sinus. From just above the periphery downward there is strong spiral sculpture of narrow crisp cords, with occasional threads, both of which override the axials, thickening somewhat over the crests of the axials. Sinus deep, rounded, its apex on

the upper part of the shoulder slope, then descending in a forwardly swinging arc, confluent with the thin-edged outer lip.

I have not seen this species, but have based my assessment upon an excellent photograph, provided by the Geology Department of the British Museum, the specimen being from the Plaisancian Pliocene of Albenga, V. Torsero, Italy. Both the original author and Cossmann (1896, Ess. Pal. Comp. 2, pl. 6, f. 3, 4) considered the type species to be clavineid, but Glibert (1860, Mem. Inst. Roy. Sci. Nat. Belg. 64, p. 35) classified it as a *Knefastia* (i.e. Turriculinae). This is a much better location but I doubt the reference to *Knefastia*, for except for the prominent subsutural fold *Stenodrillia* appears to have much in common with the turriculid genus *Comitas*.

Genus ACAMPTOGENOTIA Rovereto, 1899, Atti Soc. Ligustica 10, p. 103. Nom. nov. for *Pseudotoma* Bellardi, 1875, Bull. Soc. malac. Ital. 1, p. 20. Type (monotypy) *Murex (Pleurotoma) intortus* Brocchi, 1814 (non *Pseudotoma* Gray, 1825, non *Pseudotomus* Cope, 1872). Syn. *Pseudotomina* Finlay, 1924, Trans. N.Z. Inst. 55, p. 515, nom. nov. for *Pseudotoma* Bellardi, 1875.

Plate 4, fig. 1

Shell moderately large, 40-50 mm., or more, biconic-fusiform, with a capacious body-whorl, gradually contracted to a very short, widely open but very shallowly notched anterior canal. Protoconch of 4 -  $4\frac{1}{2}$  whorls, erect, dome-shaped, the tip flattened and planorbid, smooth except for the last whorl, which is strongly spirally ridged, but without axials. Sinus broad and shallow, occupying most of the shoulder slope. Suture not margined. Adult sculpture of spiral cords or threads and oblique nodes on a medially placed peripheral angle. The genus has possible relationship with the Austro-Neozelanic *Belophos-Austrotoma* group of genera and the North Pacific Recent and Tertiary *Megasurcula*. Range — Eocene to Pliocene of Europe, Eocene of the southeastern United States and Oligocene of northwestern America.

CHARACTERISTIC SPECIES—

EUROPEAN, Eocene to Pliocene — *acuticostata* (Kautsky, 1925); *bonellii* (Bellardi, 1839); *brevispira* (Kautsky, 1925); *colpophora* (Cossmann, 1889); *connectens* (Bellardi, 1877); *escheri* (Mayer, 1861); *florae* (Hoernes & Auinger, 1878); *genei* (Bellardi, 1847); *girundica* (Peyrot, 1931); *hirsuta* (Bellardi, 1847); *idae* (Hoernes & Auinger, 1879); *intorta* (Brocchi, 1814); *laevis* (Bellardi, 1848); *loustaii* (Deshayes, 1865); *luciae* (Hoernes & Auinger, 1891); *morreni* (Koninck, 1838); *multisulcata* (Boettger, 1906); *oligocaenica* (Bellardi, 1877); *pinnata* (Bellardi, 1877); *polysarca* (Cossmann, 1896); *praecedens* (Bellardi, 1877); *quieta* (Deshayes, 1865); *semirugosa* (Bellardi, 1877); *straeleni* (Glibert, 1854); *striolata* (Bellardi, 1877); *tournatella* (Boettger, 1906); *xeniae* (Boettger, 1906). N.W. AMERICA, Oligocene — *chaneyi* (Durham, 1944). S.W. UNITED STATES, Eocene — *axeli* Harris & Palmer, 1947; *floridana* Palmer, 1953 and *heilprini* (Aldrich, 1885). MEXICO, oligocene — *alazana* (Cooke, 1928).



Genus AUSTROTOMA Finlay, 1924,

Trans. N.Z. Inst., 55, p. 515. Type (o.d.) *Bathytoma excavata* Suter, 1917.

Plate 3, fig. 20

Shell of moderate to large size, 25 - 85 mm., of buccinoid shape, with a moderately tall spire but a capacious body-whorl, slowly tapered to a very short, deeply notched anterior canal, with a ridge-margined fasciole. Protoconch of 4-5 whorls, with a minute globular tip, the first three whorls smooth and the remainder bearing strong flat-topped spiral cords, a few thin axials towards the close. Sinus broad and shallow, occupying most of the shoulder slope. There is usually a well marked to heavy subsutural margining fold, followed by a moderate shoulder sulcus. Adult sculpture varying from almost smooth, predominantly spiral, to axials overridden by spirals, and sometimes granulose to nodulose at the points of intersection. The genus resembles *Belophos* but differs in details of the protoconch, the presence of a subsutural fold, a more deeply notched anterior canal and a ridge margined fasciole. There is also probable alliance with the North Pacific. *Megasurcula*, which has a Miocene to Recent range in California and occurs also in the Miocene of Ecuador, Japan and Korea. Range — Probably Paleocene and certainly lower Oligocene to lower Pliocene of New Zealand and Oligocene of Tasmania and Victoria. New Zealand—

CHARACTERISTIC SPECIES—

*ampla*, *clifdenica* and *cryptoconoidea* Powell, 1942; *deducta* Marwick, 1931; *echinata* Powell, 1942; *excavata* and *eximia* (Suter, 1917); *finlayi* Powell, 1938; *gemmulata* Powell, 1942; *gracilicostata* (Zittel, 1865); *hurupiensis* Dell, 1952; *inaequabilis* Marwick, 1929; *indiscreta* Finlay & Marwick, 1937; *kaiparaensis* and *lawsii* Powell, 1942; *minor* (Finlay, 1924); *molinei* Marwick, 1931; *neozelanica* (Suter, 1913) (= *sulcata* Hutton, 1873 = *suteri* Cossmann, 1916 = *huttoni* Finlay, 1924); *nervosa* Powell, 1942; *obsoleta* Finlay, 1926; *prolixa* Laws, 1940; *toreuma* Marwick, 1929. TASMANIA and VICTORIA — *inexpectata* and *janjukiensis* Powell, 1944.

Genus BELOPHOS Cossmann, 1901,

Essais Paleconch. Comp. 4, p. 162. Type (o.d.) *Bela woodsi* Tate, 1888.

Plate 4, figs. 2, 3

Shell moderately large, 30-42 mm., ovate-biconic, with a broad turreted spire and a capacious body-whorl, slowly tapered to a short deeply notched anterior canal. Protoconch of 4-5 whorls, tip minute, smooth and globular, the last two whorls reticulated by thin spirals and stout axials. Adult sculpture of prominent broadly rounded axials which extend from a median angulation, over the base to the anterior end, overridden by closely spaced crisp narrow spiral cords. Sinus very broad and shallow, occupying most of the shoulder slope. The genus appears to be nearest allied to *Austrotoma*, from which it differs mainly in the

lack of a subsutural margining fold, dominance of the axial sculpture and in the details of the protoconch. Range — Known only by the type species which is from the Oligocene Table Cape beds of Tasmania and Torquay and Spring Creek in Victoria.

Genus BELATOMINA Powell, 1942,

Bull. no. 2, Auck. Inst. Mus., p. 72. Type (o.d.) *Bela pulchra* Tate, 1888.

Plate 4, fig. 4

Shell of moderate size, 20 - 28 mm., biconic-ovate, with a moderately tall spire and an elongate-ovate body-whorl, gradually tapered to a short very weakly notched anterior canal. The suture is not marginated, the whorls not angled and the shoulder slope scarcely differentiated. Protoconch large, depressed, broadly dome-shaped, of 1½ whorls. Adult sculpture of dense crisp axials and spirals. Sinus subsutural, broad and shallowly arcuate. Range — Oligocene of Tasmania and Victoria and Miocene of Victoria.

CHARACTERISTIC SPECIES—

Oligocene — *tenuisculpta* (Tenison-Woods, 1877). Miocene — *clathrata* Powell, 1944; *pulchra* (Tate, 1888).

Genus LIRATOMINA Powell, 1942,

Bull. no. 2, Auck. Inst. Mus., p. 72. Type (o.d.) *Bela sculptilis* Tate, 1888.

Plate 4, figs. 5, 6

Shell of moderate size, 30-35 mm., ovate-biconic with a moderately tall spire and a long body-whorl, gradually tapered to a short broadly notched anterior canal. Protoconch large, smooth, rounded, of 1½ whorls, followed by a half-whorl of fine, closely spaced, brephic axials. Shoulder slope deeply concave, but without subsutural margining. Sinus a broad shallow insinuation, occupying most of the shoulder slope. Adult sculpture of crisp spirals and axials of varying strength. Range — Oligocene of Victoria and Tasmania, Miocene of Victoria and lower mid Pliocene of South Australia.

CHARACTERISTIC SPECIES—

Oligocene — *intertexta* Powell, 1944. Miocene — *crassilirata* and *sculptilis* (Tate, 1888). Pliocene — *adelaidensis* Powell, 1944.

Genus STRUTHIOLARIOPSIS Wilckens, 1904,

Revis. der Fauna der Quiriquina Schichten, Neu. Jahr. f. Min. 18. Type *Fusus ferrieri* Philippi, 1887.

Plate 4, fig. 7

Marwick (1924, Trans. N.Z. Inst. 55, p. 161) rejected this genus as a struthiolarid and claimed a more likely place for it in the Turridae, near to the Oligocene genus *Belophos* of Tasmania and Victoria, and *Austrotoma*, which has a New Zealand range of Paleocene to lower Pliocene.

Marwick's figure of *ferrieri* (l.c.p.161, text fig. 1a) shows a shell with the apical whorls and anterior end missing but the general facies resembles *Austrotoma*. The whorls have a wide steeply descending shoulder slope, showing a broad arcuate shallow sinus, a peripheral carina of strong nodes, and below this, prominent flat-topped spirals separated by deeply incised narrow grooves and crossed by fold-like axials. Range — Known only by the type species which is from the Cretaceous of Quiriquina, Chile. (Wilckens' *Struthiolariopsis similis* (1922, N.Z. Geol. Surv. Pal. Bull. 9, p. 17) from the Upper Senonian of Amuri Bluff, New Zealand is considered by Finlay & Marwick (1937, N.Z. Geol. Surv. Pal. Bull. 15, p. 70) to belong to the family Tudicidae).

#### Genus PLEUROFUSIA de Gregorio, 1890,

Monog. Faune Eoc. de l'Alabama. Palermo, p. 34. Type (o.d.) *Pleurotoma* (*Pleurofusia*) *longirostropis* de Gregorio, 1890. Syns. *Tropisurcula* Casey, 1904, Trans. Acad. Sci. St. Louis, 14 (5), p. 153. Type (s.d. Cossmann, 1906) *Drillia caseyi* Aldrich, 1903 and *Tropidosurcula* Cossmann, 1906, Essais Pal. Comp. 7, p. 222 (an unnecessary emendation).

#### Plate 4, figs. 8-10

Shell of moderate size to fairly large, up to 55 mm., elongate-fusiform, with a tall spire and a moderately long straight unnotched anterior canal. Very similar to the Fasciolarid genus *Fusinus* in general facies, except for the sinus, which is broad and shallow, its apex slightly closer to the periphery than to the suture. Protoconch blunt and paucispiral, smooth, except for a few axial riblets on the last quarter turn. Adult sculpture of swollen, long, fold-like axials, very little diminished over the shoulder slope and overridden by strong crisp spiral cords. Range — Claibornian and Jacksonian Eocene and the Vicksburgian Oligocene of the southeastern United States and Mexico, Eocene of California, India and Pakistan, Oligocene of Burma and Miocene of Burma and India.

#### CHARACTERISTIC SPECIES—

Eocene — S.E. UNITED STATES; *claibarena* Harris, 1937; *collaris* (Casey, 1903); *fluctuosa* (Harris, 1937); *hilgardi* (Casey, 1903); *huppertzi* (Harris, 1895); *longirostropis* (de Gregorio, 1890); *parahilgardina* (Palmer, 1947); *servata* (Conrad, 1847); *servatoidea* (Aldrich, 1895); *subservata* Palmer, 1947. INDIA; *amphibola* (Cossmann & Pissarro, 1909). Oligocene — S.E. UNITED STATES; *caseyi* (Aldrich, 1903); *vicksburgensis* (Casey, 1903); BURMA; *feddeni* (Noetling, 1895); *fusus* (Vredenburg, 1921). Miocene — BURMA; *iravadica* and *scala* (Vredenburg, 1921); INDIA; *phasma* (Vredenburg, 1921).

#### Genus ORTHOSURCULA Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, p. 151. Type (s. d. Gardner, 1935) *Pleurotoma longiforma* Aldrich, 1897).

#### Plate 4, fig. 11

Shell moderately large, solid, elongate fusiform, with a tall spire and a long straight un-

notched anterior canal. Typically with a protoconch of 3-3½ smooth polished whorls, rapidly increasing in size and followed by about three fourths of a whorl of short obliquely arcuate axials. Axial sculpture obsolete, surface smooth and polished, except for a few weak spirals. Periphery rounded, shoulder sulcus deep. Sinus broad but moderately deep, with the narrowly rounded apex at the lower third of the shoulder slope. The genus resembles *Turricula*, which however, has a smaller, fewer whorled protoconch and flexed anterior canal with a notched termination. Range — Eocene and Oligocene of the southern United States.

#### CHARACTERISTIC SPECIES—

Eocene: *longipera* (Harris, 1895); *phoenicea* Gardner, 1933; *pleanthillensis* Le Blanc, 1942; *tobar* Gardner, 1933. Oligocene: *longiforma* (Aldrich, 1897).

#### Genus HEMISURCULA Casey, 1904,

Trans. Acad. Sci. St. Louis 14, p. 150. Type (o.d.) *Pleurotoma silicata* Aldrich, 1899.

#### Plate 4, fig. 13

Shell of moderate to large size, 26-45 mm., elongate-fusiform, with a tall spire of straight outlines and a rounded body-whorl, gradually tapered to a moderately long straight unnotched anterior canal. Protoconch conoidal, multi-spiral and closely coiled, the nepionic whorls alone costate. Adult whorls smooth except for dense microscopic spiral lirae. Range — Eocene, Wilcox group of Alabama and the Paleocene, Midway formation of northern Mexico.

#### CHARACTERISTIC SPECIES—

Paleocene-*eosilicata* Gardner, 1945; Eocene-*silicata* (Aldrich, 1895).

Genus SULLIVANIA Harris & Palmer, 1947, Bull. Amer. Paleont. 30, no. 117, p. 432. Type (o.d.) *Pleurotoma perexilis* Aldrich, 1886.

#### Plate 4, figs. 12, 14, 15

Shell of medium size, 15-25 mm., elongate-biconical, differing from *Hemisurcula*, not only in shape, being wider and more mitriform but also in the complete absence of axial costae. There is also the addition of quite strongly developed spiral cords on the base, submarginating of the suture, and in the case of the type species, over the whole of the adult whorls. Sinus subsutural, wide and shallowly arcuate. Range — Claiborne and Jackson Eocene of the southern United States.

#### CHARACTERISTIC SPECIES—

*exilloides* (Aldrich, 1886), *hicorcola* and *fischerensis* (Harris, 1937), *perexilis* (Aldrich, 1886).

#### Genus EOSURCULA Casey, 1904,

Trans. Acad. Sci. St. Louis 14, p. 145. Type (s.d. Vokes, 1939) *Pleurotoma moorei* Gabb, 1860.

#### Plate 4, fig 16

Shell of medium size, 18-40 mm., elongate-fusiform, with a tall spire of medially angu-



lated whorls, and a narrow body-whorl, gradually tapered to a very long, straight unnotched anterior canal. Protoconch narrowly conical, multispiral and smooth. Adult sculpture of spiral lirae on the wide steeply descending shoulder slope, and strongly cordate to carinate below the shoulder angulation. Axial sculpture consists of numerous growth threads and in some species weak nodules on one or several of the peripheral cords. Sinus moderately deep, U-shaped, occupying the lower half of the shoulder slope. Range — Abundantly represented in the Claiborne Eocene of South Carolina, Alabama, Louisiana, Texas and northern Mexico.

The genus has a superficial close similarity to *Protosurcula*, but has a different protoconch, which is entirely smooth, and there is no trace of a borsonid plait.

#### CHARACTERISTIC SPECIES—

*beaumonti* (Lea, 1833), *concinna* and *helicoidea* Casey, 1904, *lesueuri* (Lea, 1833) and subsp. *beta* Harris, 1937, *moorei* (Gabb, 1860) and several subsp., Harris, 1937, *pulcherrima* (Heilprin, 1879), *quadripenta* Harris, 1937, *sanctimauritii* (Vaughan, 1896), *superpons* Harris, 1937 and subsp. *subpons* Harris, 1937, *tardereperta* Harris, 1937, *tuomeyi* (Aldrich, 1886).

Vokes (1939, Ann. N. York Acad. Sci. 38, p. 118) described an *Eosurcula capayana*, from the Californian Eocene, but the generic allocation requires to be checked.

#### Genus LEPTOSURCULA Casey, 1904,

Trans. Acad. Sci. St. Louis 14, p. 157. Type (o.d.) *Pleurotoma beadata* Harris, 1895.

Plate 4, figs. 17, 18

Shell rather large, 28 - 30 mm., elongate-fusiform, with a tall spire and a narrow body-whorl gradually tapered to a long straight unnotched anterior canal. Protoconch relatively very large, narrowly conical of 5-6 polished whorls, gradually acquiring close-set longitudinal riblets and then equally gradually the spiral lirae. Adult sculpture of prominent sharply raised narrow spiral cords overriding bluntly rounded fold-like oblique axials, strongest on the upper part of each whorl, but not reaching the lower suture. A feature of the genus is the prominent beaded subsutural margining cord. Sinus shallowly and broadly arcuate, occupying most of the shoulder slope. Range — Known only by the type species from the Eocene of Texas.

#### Genus COCHLESPIRELLA Casey, 1903,

Proc. Acad. Nat. Sci. Phil. 55, p. 279. Type (o.d.) *Fusus nanus* Lea, 1833.

Plate 4, fig. 19

Shell small, 6-8 mm., elongate-claviform, with a tall spire of medially angulated whorls, and a narrowly ovate body-whorl, contracted to a distinct neck, terminating in a short, gently twisted, very weakly emarginate anterior canal.

Protoconch narrowly conical of 3-4 smooth whorls. Adult sculpture of spiral cords and interstitial dense axial growth threads. Two closely spaced spiral cords form a narrow subsutural fold, followed by a moderately wide steeply descending shoulder slope, upon which the numerous concavely arcuate growth lines, representing successive positions of the sinus, show clearly, as in *Microdrillia*. Spire whorls with 2 to 4 spiral cords, the uppermost forming the peripheral carina, which is at, or above, middle whorl height. Spiral cords continue over the entire body-whorl, becoming more closely spaced towards the anterior end. Aperture ovate-pyriform. Outer lip thin edged, with a broadly rounded distinct sinus, occupying the whole of the shoulder slope. No apertural denticles or processes. Range — Known by two species (probably only one) and a subspecies, from the Claiborne Eocene of Alabama, South Carolina and Texas.

#### CHARACTERISTIC SPECIES—

*nanus* (Lea, 1833), *insignifica* (Heilprin, 1879) and subsp. *alabama* Harris, 1937.

Glibert (1960, Mem. Inst. Roy. Sci. Nat. Belg. 64, p. 80) erroneously considered *insignifica* to be a *Teretia*, but that genus is a daphnellid, with a diagonally cancellated protoconch.

#### Genus SURCULOMA Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, p. 153. Type (o.d.) *Pleurotoma tabulata* Conrad, 1833. Syn. *Volutapex* Harris, 1937, Palaeontographica Amer. 2 (7), p. 55. Type (o.d.) *Surcula calantica* Harris, 1937.

Plate 4, figs. 20, 21

Shell rather small, 9-18 mm., elongate-fusiform, with a tall spire of narrowly angulate whorls and a narrow body-whorl, slowly tapered to a rather short to moderately long unnotched anterior canal. Protoconch bluntly mammillate of 1½-2 whorls. Adult sculpture of distinct slightly oblique axials that do not quite reach the upper suture, are medially carinated, and from the carina downward are overridden by dense spiral lirae. Sinus broadly U-shaped, its apex about the middle of the shoulder slope.

The only apparent difference between *Surculoma* and *Volutapex* is in the presence of a relatively strong subsutural fold in the latter, but this feature varies in strength and is quite weak in *subequalis*, one of Harris' inclusions in *Volutapex*. Harris proposed *Volutapex* as a new section of *Surculoma*, and that appears to be its value at most. Range — Claiborne Eocene of Alabama, Louisiana, Mississippi and Texas.

#### CHARACTERISTIC SPECIES—

(typical) — *dumblei* (Harris, 1895), *floweri* (Harris, 1937), *leoncola* (Harris, 1895), *penrosei* (Harris, 1895) and subsp. *tabulella* Harris, 1937, *stantoni* (Vaughan, 1896), *tabulata* (Conrad, 1833) and subsp. *rignana* (Gregorio, 1890); (section *Volutapex* -*calantica* and *falsabenes* Harris, 1937, *kellogi* (Gabb, 1860), *sabinicola* Harris, 1937, *subequalis* (Conrad, 1835).



Genus *LYROSURCULA* Casey, 1904,  
Trans. Acad. Sci. St. Louis, 14, 5, p. 156. Type  
(s.d., Powell, 1942) *Lyrosurcula elegans* Casey,  
1904.

Plate 4, fig. 22

Casey described three species of this genus, *elegans*, *acuta* and *obsoleta*, which, he remarked, showed some resemblance to *Pleurofusua*. In 1942 I designated the first mentioned species as type of the genus (Bull. 2, Auck. Inst. Mus., p. 16).

Casey remarked (1c p. 157) that "a considerable number of specimens of *elegans* were obtained, but none with more than two body-whorls, and it is probable that it may really be a small species when mature". However, Casey also included in his genus two other species, *vaughani* and *sylvaerupis* (Harris, 1895) both of which are many-whorled and moderately large.

Later, Harris (1937, Palaeont. Americana 2, pp. 81-84) added a number of additional species, several of them moderately large and obviously adult, i.e., 18-19 mm. If these inclusions of Harris' represent the adult of species congeneric with the juvenile type and other similarly immature species of Casey's, then the genus is a rather normal fusiform turriculid, characterised mainly by its protoconch, which is disproportionately large, acutely conical of six whorls, the apex swollen and slightly eccentric, the first three whorls smooth, the lower three sculptured with axial riblets, increasing from fine and closely spaced to coarse and wider spaced, the sixth whorl gradually acquiring interstitial spiral lirae. Range — Claiborne Eocene of Louisiana, Texas and Alabama.

CHARACTERISTIC SPECIES—

(according to Casey and Harris) — *acuta* Casey, 1904, *columbiana* Harris, 1937, *dalli* (Cossmann, 1893) and subsp. *quadrivariata* Harris, 1937, *elegans* Casey, 1904, *funiculigera* (Cossmann, 1893), *gibbera* Harris, 1937, *obsoleta* Casey, 1904, *shaleri* (Vaughan, 1896) *sexivariata* Harris, 1937, *sylvaerupis* and *vaughani* (Harris, 1895).

Genus *MICROSURCULA* Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, 5, p. 154. Type (o.d.) *Microsurcula nucleola* Casey, 1904.

Plate 4, fig. 23, & Pla. 5, fig. 1

Shell very small, 4.8 mm. Protoconch disproportionately large, narrowly conical of five closely coiled whorls, smooth except for the lower one to three whorls, which are sculptured with fine axial riblets. Only two to three post-nuclear whorls, which are sculptured with slightly oblique, broadly rounded but narrowly crested axials, overridden by crisp narrow spiral cords. The sinus is apparently on the shoulder slope, judging from Casey's remark, in the description of *nucleola*, "these ribs are some twelve in number, elevated, rounded, extending throughout the convexity of the body-whorl and to the very fine subsutural collar above, becoming reduced and arcuately re-

versed in curvature across the fasciolar surface".

Casey named the following species as members of his genus: *nucleola* and *bellula* n.spp. and *P. georgei* Harris, *Fusus vetustus* Lea and *P. intacta* Casey, and Harris (1937, Palaeont. Americana, 2, 7, pp. 76-80) described further species and subspecies, as well as figuring the type species.

Most of the species accredited to this genus, which range in size between 4.8 and 9 mm., have the appearance of immaturity. The subfamily location of these shells is problematic; Harris (1937, l.c.) apparently considered them mangelinids, since he made *Microsurcula* a subgenus of *Raphitoma*, but on the other hand the type species, *nucleola*, has a very similar protoconch to that of *Lyrosurcula*, which, if Harris' interpretation is correct, almost certainly belongs to the Turriculinae. However without access to the complete range of Casey's and Harris' material it is pointless to speculate further at this stage. Range — Known only from the Claiborne Eocene of Alabama, South Carolina, Louisiana and Texas, and the Vicksburg Oligocene. Vokes (1939, Ann. New York Acad. Sci. 38, p. 119) described a *Microsurcula* (?) *ligna* from the Californian Eocene, but since the apex is missing, reference to that genus is purely conjectural.

CHARACTERISTIC SPECIES—

(according to Casey, 1904 and Harris, 1937) — *bellula* Casey, 1904, *carla*, *carolia* and *georgei* Harris, 1937, *intacta* (Casey, 1903), *nucleola* Casey, 1904, *pannekoekae* and *veatchi* Harris, 1937, *venusta* (Lea, 1833).

Group of cochlespirid genera

Genus *ANCISTROSYRINX* Dall, 1881,

Bull. Mus. Comp. Zool. 9, 2, p. 53. Type (o.d.) *Ancistrosyrix elegans* Dall, 1881. Syn. *Candelabrum* Dall, 1878, Bull. Mus. Comp. Zool. 5, p. 61 (non Blainville, 1830).

Plate 5, fig. 2

Shell of medium to moderately large size, 10-43 mm., rather thin shelled, pagodiform, with a moderately large carinated and coronated spire, and a long body-whorl, gradually tapered to a long straight unnotched anterior canal. Spire about three-fourths the height of the aperture. Protoconch small, slender and smooth of about 1½ whorls. Adult whorls with a broad rather flat shoulder slope, medially divided by a thin erect spiral lamella. Peripheral carina produced into numerous up-curved spines. Below the carina the whorls are sculptured with spiral cords, which may be plain or gemmulate. Outer lip thin, with a distinctive sinus; the true sinus, deep, U-shaped, situated between the suture and the lamella, and a shallower pseudo-sinus between the lamella and the peripheral carina. Operculum leaf-shaped, with a terminal nucleus. Radula (text figs. B17, 18) (*elegans* and *cedonulli*) con-



sisting of a broad but shallow based central tooth and a pair of marginals of modified "wishbone"-type, rather massive and simple pointed, but with one of the basal limbs separate and partially superimposed upon the larger member. Range — Recent, deep water, down to over 800 fathoms, Florida, the Caribbean, West Mexico and Panama, Pliocene of Panama, Miocene of Jamaica, Trinidad and Panama, and the Claiborne and Jackson Eocene of the south east United States.

#### CHARACTERISTIC SPECIES—

Recent — *cedonulli* (Reeve, 1843), *elegans* Dall, 1881, *radiata* Dall, 1889 and subsp. *cubana* Clench & Aguayo, 1940. Pliocene — *cedonulli* subsp. *reevei* Olsson, 1942. Miocene — *dalli* Olsson, 1922, *miranda* (Guppy, 1882). Eocene — *columbaria* (Aldrich, 1886) and subsp. *petropolis* Harris, 1937.

#### Genus COCHLESPIRA Conrad, 1865,

Amer. Journ. Conch. 1, p. 19. Type (by virtual monotypy) *Pleurotoma cristata* Conrad, 1847. Syns. *Coronasyrinx* Powell, 1944, Rec. Auck. Inst. Mus. 3, 1, p. 22. Type (o.d.) *Coronasyrinx venusta* Powell, 1944. *Rouaultia* Bellardi, 1878, Mem. Accad. Sci. Torino, 2, 29, p. 223. Type (Cossmann, 1896, p. 55) *Pleurotoma subterebralis* Bellardi, 1847.

#### Plate 5, figs. 3-6

I am indebted to Dr. F. Stearns Mac Neil for pointing out that Cossmann's designation of *Pleurotoma engonata* Conrad, 1865, as type of *Cochlespira* Conrad, 1865, is invalid, since the name *engonia* was a nomen nudum at the time of publication of the genus, and was not formally described until two months later. In effect this makes *cristata* monotypic of the genus, alters the character of the genus, and at the same time demands re-orientation of other names.

There now appear to be no marked differences between the respective types of *Cochlespira*, *Coronasyrinx* and *Rouaultia*, the two latter becoming synonym of the former. Thus the genus *Cochlespira* becomes available in a much wider sense, to take in most of the *Ancistrosyrinx*-like shells that do not have the shoulder sulcus divided by a spiral lamella.

For *engonata*, formerly considered the type of *Cochlespira*, the genus *Cochlespiropsis* Casey, 1904, becomes available. This is a group of Claiborne Eocene shells with simple carinated whorls.

A New Zealand Eocene genus, *Tahusyrinx* Powell, 1942, resembles *Cochlespira*, but has a different protoconch, which is small, polygyrate, broadly conical of 4 whorls, first two whorls smooth and rounded, the remaining ones carinated low down, and distantly obscurely axially ribbed.

Shell of moderately to large size, 14-50 mm., elongate-pagodiform, with a tall spire, and a long body-whorl, slowly tapered to a long unnotched anterior canal. Protoconch subcylindrical of two smooth whorls. Adult whorls with a more or less median placed peripheral carina, flange-like, with pointed serrated nodes or

coronated by upcurved spinose processes. Suture usually submargined by a spiral band of oblique oval gemmules; the rest of the concave shoulder slope either smooth or with fine spiral lirations. Below the peripheral carina the whorls are densely sculptured with closely spaced strong beaded spiral cords, a few stronger ones on the upper part of the base. Some species have the spiral sculpture almost obsolete, but the gemmulate to serrated keel is characteristic. Sinus moderately deep, broadly arcuate, occupying most of the shoulder slope. Radula with a very broad-based, unicuspid central tooth and modified wishbone-type marginals, which are foliated-based in *pulchella* (text fig. B19) but with a superimposed smaller plate in *crispulata* (text fig. B20). Range — Recent, India to Japan, Miocene of Okinawa and Italy, Oligocene of Victoria, South Australia and Germany, Eocene of France, England and the S.E. United States.

#### CHARACTERISTIC SPECIES—

Recent — *kawamurai* (Kuroda, 1958), *pulchella* (Schepman, 1913), *pulcherrissima* (Kuroda, 1958), *travancorica* (Smith, 1896) and subsp. *granulata* (Smith, 1904). Miocene (Okinawa — *takabanarensis* Mac Neil, 1960, (Italy), *subterebralis* (Bellardi, 1847). Oligocene (Germany) — *perspirata* (Koenen, 1865), *volgeri* (Philippi, 1847), (Australia) — *semitiplana* and *venusta* (Powell, 1944). Eocene (Europe) — *gyrata* (Edwards, 1856), *terebralis* (Lamarck, 1804) and subsp. *ditropis* and *pulcherrima* (Edwards, 1856), (S.E. United States) — *bella* Conrad, 1865 and subsp. *planata* and *polita* Harris, 1937, *cristata* (Conrad, 1847) and subsp. *greggi* Harris, 1937.

#### Genus COCHLESPIROPSIS Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, 5, p. 143. Type (s.d. Cossmann, 1906) *Pleurotoma engonata* Conrad, 1865 (= *C. blanda* Casey, 1904).

#### Plate 5, fig. 7

Shell of moderate size, 25-30 mm., narrowly pagodiform-biconic, with a tall spire of mediaily sharply carinated whorls, and a long ovate carinated body-whorl, gradually tapered to a moderately long, twisted, weakly notched anterior canal. Protoconch apparently paucispiral and smooth. Adult whorls with a conspicuous median smooth peripheral carina, and an overall very dense sculpture of fine spiral lirae, weaker over the shoulder slope. Aperture, long, narrowly pyriform. Outer lip thin, with a rather deep subsutural sinus, its U-shaped apex below the middle of the shoulder slope, and below, there is a broad shallow stromboid notch. Inner lip a narrow smooth callus with a defined edge, bridging a narrow crescentic false umbilicus below. Range — Known only by the type species, which is apparently confined to the lower Claiborne Eocene of Texas.

#### Genus TAHUSYRINX Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 68. Type (o.d.) *Parasyrinx finlayi* Allan, 1926.

#### Plate 5, fig. 8

Shell rather small, 17 mm., elongate-pagodi-

form, with a tall spire and a long body-whorl, gradually tapered to a long straight unnotched anterior canal. Protoconch small, broadly conical of four whorls, first two smooth and rounded, the remaining ones carinated towards the lower suture, and distantly obscurely axially ribbed. Adult whorls dominated by a median flange-like keel, with a serrated edge. Above the keel the rather wide concave shoulder slope is devoid of spirals, but bears numerous axial growth lines which follow the curve of the sinus. Below the keel there are rather widely spaced spiral cords, of which two occur between the keel and the lower suture. Sinus deep, U-shaped, with divergent angles of approach, the apex at about the middle of the shoulder slope.

Except for a different style of protoconch the genus resembles *Cochlespira*. Range — Known only by the type species which is from the Tahuian stage, upper Eocene of the Waihao greensands, McCullough's Bridge, South Canterbury, New Zealand.

#### Genus PARASYRINX Finlay, 1924,

Trans. N.Z. Inst. 55, p. 514. Type (o.d.) *Pleurotoma alta* Harris, 1897.

##### Plate 5, fig. 10

Shell of moderate size, 20-40 mm., elongate-fusiform, with a tall pagodiform spire and a long slender unnotched anterior canal. Protoconch blunt of two rounded smooth whorls. Adult whorls dominated by a narrow, sharp, flange-like smooth keel, at below middle whorl height. A weak subkeel or angulation encircles the base at about the level of the top of the aperture. Surface smooth to weakly lirate. Sinus deep, and broadly rounded at its apex, which occupies the lower half of the shoulder slope. Range — Known only from the Waitakian middle Oligocene to the Awamoan upper Oligocene of New Zealand.

##### CHARACTERISTIC SPECIES—

*alta* (Harris, 1897) (= *pagoda* Hutton, 1873), *sub-alta* (Marshall & Murdoch, 1919).

#### Subgenus LIRASYRINX Powell, 1942 (of *Parasyrinx*),

Bull. 2, Auck. Inst. Mus., p. 69. Type (o.d.) *Lirasyrinx anomala* Powell, 1942.

##### Plate 5, fig. 9

Shell small, incomplete, estimated at about 10 mm., broadly fusiform with a very sharp peripheral keel. Protoconch obtusely conical of  $2\frac{1}{2}$  whorls, with a small smooth planorbid tip, followed by two rounded whorls which are strongly spirally lirate. Adult whorls with a conspicuous sharp submedian flange-like keel, deeply concave both above and below, the shoulder slope slightly the longer. Surface covered with closely spaced moderately strong spiral lirae and a few, much finer ones, on the underside of the keel. Aperture and anterior

end broken away in the unique type but probably with a long slender anterior canal. Sinus very deep and broadly rounded, occupying most of the shoulder slope. Range — Known only by the type species which is from the Duntroonian lower Oligocene of Wharekuri, Waitaki Valley, New Zealand.

The subgenus differs from *Parasyrinx* in having stronger spiral sculpture and a more prominent peripheral keel, as well as in the form of the protoconch, which is strongly spirally lirate; that of *Parasyrinx* is blunt and smooth of two whorls.

#### GENUS COSMASYRINX Marwick, 1931,

New Zealand Geol. Surv. Pal. Bull. 13, p. 138. Type (o.d.) *Cosmasyrinx monilifera* Marwick, 1931.

##### Plate 5, fig. 11

Rather small shells, 12-14 mm., broadly fusiform with pagodiform spire and long unnotched anterior canal. Related to *Parasyrinx*, but with a strong moniliform keel, set almost at the lower suture. Protoconch paucispiral, smooth, erect, with a large bulbous nucleus. Sinus deep, broadly arcuate, occupying most of the shoulder area. Known only from the Upper Oligocene and Miocene of New Zealand.

##### CHARACTERISTIC SPECIES—

Upper Oligocene: *semilirata* Powell, 1942. Miocene: *ardua*, *latior*, *monilifera* and *toreumera* Marwick, 1931.

#### Genus AFORIA Dall, 1889,

Bull. Mus. Comp. Zool. 18, p. 99. Type (o.d.) *Pleurotoma circinata* Dall, 1873. Syn. *Irenosyrinx* Dall, 1908, Bull. Mus. Comp. Zool. 43, 6, p. 257. Type (o.d.) *Pleurotoma (Irenosyrinx) goodei* (Dall, 1888).

##### Plate 5, figs. 12, 13

Shell large to very large, up to 90 mm., thin, elongate-fusiform, with a tall spire and a long slightly flexed and recurved unnotched anterior canal. The apex is almost invariably eroded or damaged, but Bartsch (1945, Journ. Wash. Acad. Sci. 35, 12, p. 388) described the protoconch as slender and multispiral. Adult whorls conspicuously medially carinated, the surface sculptured with numerous flat-topped spiral cords, defined by incised lines. This sculpture is confined to the lower half of the whorls and base, the shoulder slope being smooth, except for incremental growth threads marking successive positions of the sinus. The sinus is deep, U-shaped, with a rounded apex, occupying the lower half of the shoulder slope. In a fresh state the whole shell is covered by a thin shining buff-coloured periostracum. Occasional examples (*circinata*) develop a basal ridge that forms a spout-like subtubular projection on the lower outer lip. A similar feature often occurs in the turrinid genera *Gemmula*, *Pinguigemmula* and *Ptychosyrinx*. Operculum corneous, varying in form from roughly ovate to quadrate, the nucleus terminal or subterminal, and



incurred in most instances. Dall (1908, l.c.) introduced *Irenosyrinx* for deep-water Eastern Pacific shells stated to have a different operculum from that of the deep-water North Pacific *Aforia* group. The *Irenosyrinx* operculum was stated to be paucispiral in the juvenile, later becoming surrounded by concentric additions, leaving the nucleus subcentral. However, even in the adult, the *Irenosyrinx* operculum remains vestigial so far as size is concerned, and allowing for the considerable individual fluctuations in the shape of the operculum in northern *Aforia*, there appears to be no real reason for recognising two genera, particularly since the radula is of identical form in North Pacific, Eastern Pacific and Antarctic species.

The radula (text figs. B21-25) consists of a large broad-based unicuspid central, no laterals, and a pair of modified 'wishbone'-type marginals, consisting of a massive simple pointed tooth, but with the distal basal limb severed and superimposed. This distal limb may be either small and slender or upwards of half the size of the tooth proper. In one species, *magnifica* (text fig. B22), the basal limbs are not severed, and in *persimilis* (text fig. B21), the central is vestigial.

The radula is interesting in that the central has become extra large to fill the space that otherwise would be occupied by a lateral, and also, the modified 'wishbone'-type marginals indicate that the genus is not very far removed from the turriculids.

The distributional pattern of the genus is an excellent example of 'bipolarity' by the process of going deep under equatorial waters, in part assisted by the upwelling of Antarctic water, which factors combine to provide the requisite bottom temperature range.

Range — Recent, Japan and Aleutian chain to north west America, down and off the west coast of both North and South America, along the Scotia Arc to Antarctica, the Argentine Basin, and across the Southern Ocean to Kerguelen and Heard Islands at depths varying between 60 and 1500 fathoms. Pliocene of Japan and Miocene to Oligocene of Washington.

#### CHARACTERISTIC SPECIES—

Recent (North Pacific) — *chosenensis* Bartsch, 1945, *circinata* (Dall, 1873) (= *diomedea* Bartsch, 1945 = *hondoana* Dall, 1925 = *insignis* Jeffreys, 1883 = *okhotskensis* and *sakhalinensis* Bartsch, 1945), *crebristriata* (Dall, 1908), (South eastern Pacific and South Atlantic to Antarctica) — *clara* (Martens, 1880), *goniodes* (Watson, 1881), *goodei* and subsp. *persimilis* (Dall, 1889), *magnifica* (Strebel, 1908), *staminea* and *trilix* (Watson, 1881). Pliocene (Japan) — *circinata* subsp. *minatoensis* (Otuka, 1949), *otohime* (Ozaki, 1958). Miocene — Oligocene (Washington) — *borgenae* (Tegland, 1933), *campbelli* Durham, 1944, *clallamensis* (Weaver, 1916), *marrowstonensis* (Durham, 1944).

#### Genus STEIRAXIS Dall, 1895,

Proc. U.S. Nat. Mus. 18, p. 14. Type (o.d.) *Pleurotoma* (*Steiraxis*) *aulaca* Dall, 1895.

#### Plate 5, fig. 14

Shell rather large, 60 mm., rather broadly fusiform, with a moderately tall spire of convex to subangulate whorls, and a rounded body-whorl, quickly contracted to a long flexed spout-like anterior canal. Protoconch unknown. Adult whorls crossed by numerous narrow sharply raised spiral cords. Sinus subsutural, broadly arcuate and shallow, without a fasciole. Colour white, covered by a pale straw-coloured periostracum. Operculum ovate, with an incurved spiral nucleus at the terminal end. Radula (text fig. B25) consisting of a narrow-based, unicuspid central tooth, no laterals, and a pair of narrow simple pointed marginals, with the distal basal limb separated and partially superimposed. Range — Off Acapulco, West Mexico in 1879 fathoms and Gulf of Panama in 1772 fathoms.

The genus differs from *Aforia* in the lack of a shoulder sulcus, in having a much shallower anal sinus, and stronger overall sculpture. The radula differs markedly in that only a vestige of the central tooth remains.

Genus DECOLLIDRILLIA Habe & Ito, 1965, Venus, 24 (1), p. 43, pl. 4, fig. 6. Type (o.d.) *D. nigra* Habe & Ito, 1965.

This is based upon a small shell, 11.5-14 mm. in height, which is known only in a decolated state. It is impossible, from the brief description and poor figure, to evaluate this genus, the sole species of which is described as follows — "The shell is rather small, solid, usually with only two remaining whorls, other upper whorls being decapitated in the adult specimens. The body whorl has two stout spiral cords above the periphery and also two cords on the base, crossed by the growth lines. The aperture is ovate with a short siphonal canal and white within. The outer margin is rounded with a shallow sinus below the suture. The surface of the shell is usually soiled with black dust". Range — Known only from south of Erimomisaki, 200 metres, Hokkaido, Japan.

#### Subfamily TURRINAE (Pleurotominae emended) Swainson, 1840

Members of this subfamily are mostly of moderate to large size, and of narrowly fusiform shape, with a tall spire and a long straight anterior canal, but in some genera the anterior end is truncated.

They are distinguished from the Turriculinae by their sinus, which is either on the peripheral carina or on a minor spiral immediately above the periphery. The sinus varies between a broadly open V, and a deep narrow slit.



The operculum is leaf-shaped with a terminal nucleus, and the radula consists of a pair of wishbone-type marginals, with or without a vestigial to well developed, unicuspid, broad-based, central tooth. Often the basal limbs of the marginal are bridged by a thin plate; in others the distal basal limb is severed.

The peripheral sinus is not always indicative of the Turrinae, however, for that type of sinus is found also in some borsonids. These differ from the turrinids in having well developed pillar plications, and a radula of long slender curved marginals, often barbed at the tip.

The turrinids are widely distributed and abundantly represented back to the Paleocene, and apparently originated from the Turriculinae.

Genus *EOPLEUROTOMA* Cossmann, 1889, Ann. Soc. Malac. Belgique, 24, p. 269. Type (o.d.) *Pleurotoma multcostata* Deshayes, 1834 = *Eodrillia* Casey, 1904, Trans. St. Louis Academy, 14, p. 159. Type (s.d. Cossmann, 1904) *Pleurotoma depygis* Conrad, 1833.

#### Plate 5, fig. 15

Shell moderate sized, up to 25 mm., elongate-fusiform with a tall spire but a relatively short anterior canal. A Paleocene-Eocene relative of *Gemmula*, in which the axial sculpture is in the form of long narrow flexuous ribs which thicken at the periphery to form a row of laterally compressed nodules. Protoconch small, smooth and paucispiral. Sinus broadly V-shaped, its apex extending a little above the peripheral nodules. Range — Paleocene and Eocene of Europe, Eocene of the southwestern United States and Peru. Recorded also from the Tertiary of southern and southeastern Asia and Japan, but the species require re-evaluation.

#### CHARACTERISTIC SPECIES—

EUROPEAN EOCENE: *bernayi* (Boury, 1899); *bezanconi* (Boury, 1899); *bicatenata* (Lamarck, 1804); *cedilla* (Edwards, 1861); *curvicosta* (Lamarck, 1904); *distans* (Deshayes, 1865); *distanticosta* (Cossmann & Pissarro, 1900); *expedita* (Deshayes, 1865); *flexicosta* (Boury, 1899); *fluctuosa* (Deshayes, 1865); *francisci* (Raincourt, 1876); *fresvillensis* (Cossmann & Pissarro, 1900); *granifera* (Deshayes, 1834); *inculta* (Sowerby, 1850); *insueta* (Boury, 1899); *lajonkairi* (Deshayes, 1834); *larteti* (Deshayes, 1865); *lima* (Edwards, 1861); *multicostata* (Deshayes, 1834); *multinoda* (Lamarck, 1804); *oligocolpa* (Cossmann, 1889); *plicaria* (Deshayes, 1834); *pourcyensis* (Cossmann, 1901); *propinqua* (Deshayes, 1865); *rotella* (Edwards, 1861); *rudiusscula* (Cossmann, 1889); *scalarata* (Edwards, 1861); *specialis* (Boury, 1899); *spreti* (Deshayes, 1865); *undata* (Lamarck, 1804). NORTH AMERICAN EOCENE — *adolescens* Harris, 1937; *albirupis* Harris, 1947; *cainei* (Harris, 1899); *carya* Harris, 1937; *cochlea* Harris, 1937; *depygis* (Conrad, 1833); *desnoyersii* (Lea, 1833); *gemmavia* Harris, 1937; *hoeninghausii* (Lea, 1833); *lisboncola* Harris, 1937; *nupera* (Conrad, 1833); *orangeburgensis* Harris, 1937; *ouachitensis* Harris, 1937; *plumbella* Harris, 1937; *politica* Harris, 1937; *rugatina* Harris, 1937; *rugosa* (Lea, 1833); *sabinaria* Harris, 1937; *sayi* (Lea, 1833); *thyroidifera* Harris, 1937. PERU

— *paytensis* Olsson, 1930; *wiedeyi* Olsson, 1930. EUROPEAN PALEOCENE — *selandica* (Koenen, 1885).

Subgenus *OXYACRUM* Cossmann, 1899 (of *Eopleurotoma*).

Ann. Soc. Malac. Belgique, 24, p. 274. Type (o.d.) *Pleurotoma oblitterata* Deshayes, 1834.

#### Plate 5, fig. 16

Members of this subgenus are very similar to *Eopleurotoma* but have a tall narrowly conical protoconch of  $4\frac{1}{2}$  smooth whorls, plus a whorl of brephic axials. It occurs in the Eocene of Europe and England.

#### CHARACTERISTIC SPECIES—

*constricta* (Edwards, 1861); *inflexa* (Lamarck, 1804); *lepta* (Edwards, 1861); *oblitterata* (Deshayes, 1834).

Genus *EOTURRIS* Finlay & Marwick, 1937, New Zealand Geol. Surv. Pal. Bull. 15, p. 114. Type (o.d.) *Turris complicatus* Suter, 1917.

#### Plate 5, fig. 17

This genus shows relationship with the European-North American lower Tertiary *Eopleurotoma*. Both have the sinus spreading from the peripheral carina on to the shoulder. The respective protoconchs, however, differ considerably; that of *Eopleurotoma* is small, smooth and paucispiral, that of *Eoturris* is narrow, elongate-conic, with axials over the last quarter whorl. Range — the genus is known only from the Eocene to the upper Oligocene of New Zealand.

#### CHARACTERISTIC SPECIES—

EOCENE; *complicatus* (Suter, 1917), *neglectus* Suter, 1917, *multicinctus* (Marshall, 1917). OLIGOCENE; *uttleyi* (Suter, 1917).

Genus *CAMPYLACRUM* Finlay & Marwick, 1937,

New Zealand Geol. Surv. Palaeont. Bull. 15, p. 86. Type (o.d.) *Campylacrum sanum* Finlay & Marwick, 1937.

#### Plate 5, fig. 18

Shell small, 8 - 9 mm., elongate - fusiform with a tall spire and moderately long unnotched anterior canal, straight for three quarters of its length, then slightly twisted. Protoconch polygyrate, conic, of four smooth whorls. Adult sculpture of strong axial nodes, both at the periphery and also on the subsutural fold, the whole surface crossed by rather weak spirals. Sinus rather wide, moderately deep, bluntly triangular, its apex just above the peripheral nodes. The genus appears to be closely related to the European Eocene *Oxyacrum*, which differs chiefly in having the sinus in a higher position, in a shoulder sulcus, above the peripheral nodules. Range — two species from the Paleocene of Wangaloa, New Zealand.

#### CHARACTERISTIC SPECIES—

*debile* Finlay & Marwick, 1937 and *sanum* Finlay & Marwick, 1937.



## Genus EPALXIS Cossmann, 1889,

Ann. Soc. malac. Belg. 24, p. 254. Type (o.d.) *Pleurotoma crenulata* Lamarck, 1804.

## Plate 5, fig. 19

Shell of moderate size, 12-18 mm., narrowly fusiform, with a tall spire, and an elongated body-whorl, produced into a moderately long, slightly flexed, and weakly notched anterior canal. Protoconch very small, narrowly conical, of  $1\frac{1}{2}$  smooth whorls, the tip off centre. Adult whorls broadly bluntly carinated at or below the middle, on the spire whorls. Sculpture consisting of numerous flexuous axial folds, which commence strongly at the suture, diminish over the shoulder sulcus, and become very strong, as crescentic nodes, over the peripheral carina, after which they fade out over the base. The whole surface is crossed by weak spiral threads which become stronger over the base. Sinus moderately deep, widely open, its broadly rounded apex peripheral, and extending a little above the carina. The genus was compared with *Bathytoma* by its author but the relationship appears to be nearer to *Eopleurotoma*. Range — Auversian, Bartonian. Ypresian and Lutetian Eocene of France.

## CHARACTERISTIC SPECIES—

*lemoinei* (Boury, 1899), *multigyrata* (Deshayes, *bilirata* (Boury, 1899), *crenulata* (Lamarck, 1804), 1865), *ventricosa* (Lamarck, 1804).

## Genus CORONIA Gregorio, 1890,

Ann. de Geol. et de Paléontologie, Palermo, 7, p. 23. Type (s.d. Cossmann, 1896) *Pleurotoma acutirostra* Conrad, 1835=Pl. *childreni* Lea, 1833.

## Plate 5, fig. 20

Shell very similar to *gemmula* but with a different protoconch, which is of two or more smooth rapidly enlarging whorls, succeeded by one or more convex whorls, sculptured with numerous obliquely arcuate costae. Usually considered to be a synonym of *Gemmula* but allowed full generic status by Harris & Palmer (1947, Bull. Amer. Paleont. 30, no. 117, p. 418). Range — Claiborne Eocene of the southern United States and northern Mexico.

## CHARACTERISTIC SPECIES—

*amica* (Casey, 1903), *childreni* (Lea, 1833) (= *acutirostra* Conrad, 1835), *conjuncta* (Casey, 1904), *genitiva* (Casey, 1904), *ludonorma* Harris & Palmer, 1947, *montgomeryensis* (Harris, 1937), *nodulina* (Casey, 1904) and *weisbordi* (Harris, 1937).

Subgenus INFRACORONIA Harris & Palmer, 1947 (of *Coronia*),

Bull. Amer. Paleont., Ithaca, 30, p. 423. Type (o.d.) *Gemmula ludoviciana* Vaughan, 1896.

## Plate 5, fig. 21

Compared with *Coronia*, from which it was stated to differ in having the dentate carina at the base of each whorl, just above the suture, and the absence of a subsutural band. It was proposed, however as a subgenus of *Sinistrella*.

Range — Lower Claiborne and Jackson Eocene of Louisiana, Southern United States.

## CHARACTERISTIC SPECIES—

*ludoviciana* (Vaughan, 1896) and var. *normani* (Harris, 1937).

## Genus HESPERITURRIS Gardner, 1945,

Memoirs no. 11, Geol. Soc. America, p. 237. Type (o.d.) *Turris nodocarinata* Gabb, 1860.

## Plate 5, fig. 22

This is another member of the *Gemmula* complex, which was diagnosed primarily upon the form of the protoconch, described as of 5-5½ volutions, the initial turn minute and largely immersed, the 3-3½ succeeding whorls also smooth and shining, broadly rounded, and increasing rather rapidly in diameter and the final whorl in whole or in part axially costate. Adult shell medium sized, 12-24 mm., with a tall spire but a truncated anterior canal. The sculpture is of nodules on a peripheral carina just above the lower suture. Sinus broadly U-shaped, moderately deep, the axis running closer to the periphery than to the suture. The genus appears to be confined to the lower Claiborne Eocene of the southern United States and northern Mexico.

## CHARACTERISTIC SPECIES—

*amichel* Gardner, 1945; *nodocarinata* (Gabb, 1860); *zacatensis* Gardner, 1945.

## Genus TRYPANOTOMA Cossmann, 1893,

Essais de Paléont. Comp. 2, p. 109\* Type (o.d.) *Pleurotoma terebriformis* Meyer, 1886.

## Plate 5, figs. 24, 25

Shell small, 8 - 11 mm., with a tall almost straight-sided spire and a narrowly ovate body-whorl, with a very short canal. Protoconch blunt of  $2\frac{1}{2}$  smooth whorls. Adult sculpture consisting of a smooth subsutural margining cord, and another below, emergent at the lower suture, and between these two cords a peripheral row of prominent nodules; base with closely spaced spiral cords. Sinus weak, peripheral. Range — Claiborne and Jackson Eocene of Alabama and Louisiana and Tejon Eocene of California.

## CHARACTERISTIC SPECIES—

*carlottae* Harris, 1899; *longispira* Casey, 1904; *melanella* Harris, 1937; *obtusa* Casey, 1904; *stocki* Dickerson, 1916; *terebriformis* (Meyer, 1886) and subsp. *curta* and *cooperi* Harris, 1937.

\*Cossmann cited the date as 1893, but the first publication of the name seems to be in volume 2 of the 'Essais', i.e., 1896.

## Genus TRYPANOTOPSIS Gardner, 1945,

Geol. Soc. Amer. Mem. 11, p. 243. Type (o.d.) *Turris texana* Gabb, 1860.

## Plate 5, fig. 23

Shell small, 10.5 mm., narrowly fusiform, with a tall rather straight-sided spire and a narrow ovate body-whorl, with a short straight

anterior canal. Protoconch obtuse, smooth, of about two whorls. Adult sculpture of numerous flat-topped spiral cords, weak on the shoulder slope but strong from the periphery to the anterior end. Upper spire whorls axially costate, but axials become progressively weaker and finally obsolete before the body-whorl is reached. The anal sinus is described as broad spreading U-shaped. The genus seems to be close to *Trypanotoma*, which has a similar protoconch and sinus but the adult sculpture is different, with its margining of the sutures, both above and below, and strong peripheral nodes between. Range — Known only by the type species from the lower Claiborne Eocene of Texas.

#### Genus SINISTRELLA Meyer, 1887,

Ber. Senckenb. naturf. Gesell. p. 18. Type (monotypy) *Triforis americanus* Aldrich, 1885.

#### Plate 5, fig. 26

This is usually considered to be merely a sinistral form of *Trypanotoma*, but Harris and Palmer (1947, Bull. Amer. Paleont., Ithaca 30, p. 422) gave it full generic status, in association with *Coronia*, *Trypanotoma* and *Infra-cornia*. Range — Known only by the type species, a small shell, ca 11 mm., which is always sinistral and comes from the Jackson Eocene of Mississippi.

#### Genus HEMIPLEUROTOMA Cossmann, 1889,

Ann. Soc. Malac. Belgique, 24, p. 264. Type (o.d.) *Pleurotoma archimedis* Bellardi, 1878. Type (s.d., Cossmann, 1896, Essais de Paleoconch. Comp. 2, p. 78) (invalid) *Pleurotoma denticula* Basterot, 1825.

#### Plate 6, fig. 1

This name is based upon a very rare fossil from the Helvetian middle Miocene of Italy, but in 1896, Cossmann invalidly proposed *denticula* Basterot, 1825, as neotype of his genus, but the original citation must stand. Based upon this original type designation, about the only distinguishing characteristic of *Hemipleurotoma* is the very broadly open V-shaped sinus, otherwise it conforms with *Gemmula*. Glibert (1960, Mem. Inst. Roy. Sci. Nat. Belg. 2 (64), p. 4) included *Hemipleurotoma* in the synonymy of *Gemmula*. The genus has been erroneously applied to the Recent *Turris cryptorrhapha* (Sowerby, 1825).

#### Genus GEMMULA Weinkauff, 1875,

Jahrb. Deutsch. Mal. Gesell., 2, p. 287. Type (s.d., Cossmann, 1896) *Pleurotoma gemmata* Reeve, 1843 = *Gemmula hindsiana* Berry, 1958. Syn. EUGEMMULA Iredale, 1931. Type (o.d.) *E. hawleyi* Iredale, 1931.

#### Plate 6, fig. 2

Shell rather large, 24–88 mm., elongate-fusiform, with tall spire and long straight un-

notched anterior canal. Protoconch tall, conical, polygyrate and axially costate. Adult sculpture of spiral keels and cords, the peripheral keel mostly double, often flanged and always studded with gemmules, often cog-like in vertically fused pairs. Sinus deep and narrow, on the peripheral carina. Operculum leaf-shaped, with a terminal nucleus. Radula consisting either of a pair of wishbone-shaped marginals only (*hombroni*; text fig. C50), or with the addition of a central tooth, which may be vestigial (*congener diomedea*; text fig. C51), to fully formed, unicuspid, with a large broad base (*gilchristi*; text fig. C53).

Coloration, usually with peripheral dots of brown alternating with the gemmules and sometimes with the addition of brownish spiral bands and zones. Range — Most warm seas and abundant in the Tertiary, back to the Paleocene. The genus is abundantly represented in the Tertiary of both Europe and North America, but the greatest representation is now in the Indo-Pacific. Very few species still exist in Caribbean-Panamic waters, and now there are none in Mediterranean and West African waters, where *Gemmula* is replaced by *Fusiturris*.

#### CHARACTERISTIC SPECIES—

Recent, Indo-Pacific — *aethiopica* (Thiele, 1925); *amabilis* (Weinkauff, 1875); *congener* (Smith, 1894) and subsp. *cosmoi* (Sykes, 1930) and *diomedea* Powell, 1964; *dampierana* Powell, 1964; *ducalis* (Thiele, 1925); *gemma* (Martens, 1902); *gilchristi* (Sowerby, 1902); *graeffei* (Weinkauff, 1875); *hawleyi* (Iredale, 1931); *hombroni* (Hedley, 1922) (= *fusca* Hombroni & Jacquinot, 1853); *kieneri* (Dumet, 1840); *martini* (Tesch, 1915) (= *valdiviae* Thiele, 1925); *monilifera* (Pease, 1860) (= *aelomitra* Dall ms., Tinker, 1952); *murrayi* Powell, 1964; *praesignis* (Smith, 1895); *rotatilis* (Martens, 1902); *sibogae* (Schepman, 1913); *sibukoensis* Powell, 1964; *speciosa* (Reeve, 1843) (= *carinata* Gray, 1834 = *guadarensis* Melvill, 1917); *vagata* (Smith, 1895). Southeastern United States — *perisclida* (Dall, 1889). Tropical West America — *hindsiana* Berry, 1958 (= *gemmata* Reeve, 1843). Tertiary, Indo-Pacific; Pliocene — *martini* (Tesch, 1915); *pulchella* Shuto, 1961. Miocene — *birmanica* (Vredenburg, 1921); *congener mekranica* (Vredenburg, 1925); *imitatrix* (Martin, 1916); *iris* (Vredenburg, 1921); *karangensis* (Martin, 1895); *kieneri ryukyuensis* Mac Neil, 1960; *kotorai* (Nomura & Zinbo, 1935); *miocoronifera* Powell, 1964; *sindiensis* (Vredenburg, 1925); *thyrsus* (Vredenburg, 1921). Eocene — *kishimaensis* Shuto & Ueda, 1963; *pakistanica* (Eames, 1952); *soriensis* (Eames, 1952). Tertiary, Australia and New Zealand — Pliocene — *disjuncta* Laws, 1936; *orba* Marwick, 1931; *peraspera* Marwick, 1931; Miocene — *clifdenensis* Powell, 1942; *gellibrandensis* Chapple, 1934; *samueli* (Tension-Woods, 1879). Oligocene — *kaiparaensis* (Marshall, 1918); *longwoodensis* Powell, 1942; *ornata* (Marshall, 1918); *lawsi* Powell, 1942; Eocene — *bimarginata* (Suter, 1917); *duplex* (Suter, 1917); *margaritata* (Marshall, 1919); *polita* (Marshall, 1919); *reticulata* (Marshall, 1919); *waihaoensis* Finlay, 1924 (= *regius* Suter, 1917). South-eastern United States: Eocene — *alternata* (Conrad, 1833), *carodenta* Harris, 1937 and *margaritosa* Casey, 1904.



Subgenus UNEDOGEEMMULA Mac Neil, 1960. (of *Gemmula*).

U.S. Geol. Surv. Prof. Paper 339, p. 101. Type (o.d.) *Pleurotoma unedo* Kiener, 1939-40.

Plate 6, fig. 3

Shell large, 30-105 mm., fusiform, with tall spire and long straight unnotched anterior canal. Protoconch multispiral, narrowly conic, typically smooth of 3-3½ whorls, terminating in a half whorl of brephic axials, varying to 2 whorls smooth followed by 2 axially costate. Sinus peripheral, a deep and narrow slit at the termination of a sinus rib formed of two, sometimes three, sharply raised cords. Coloration plain olive-brown, or alternatively with irregularly disposed reddish-brown dots on a pale ground to larger maculations and axial streaks. Operculum leaf-shaped with a terminal nucleus.

Radula (text fig. C54) of modified wish-bone-type, consisting of a pair of stout hollow-based conical marginals, which taper to a sharp point (*unedo*). There is a resemblance to the radula of *Xenuroturris*.

The subgenus is similar to *Lophiotoma* in its adult facies, having a smooth peripheral keel, but the early whorls show distinct peripheral granulations. It could be regarded as of *Gemmula* origin tending towards obsolescence of the gemmules, or alternately, as a *Lophiotoma*, exhibiting vestigial evidence of the probable origin of that genus in *Gemmula*, which has a long ancestry back to as early as the Paleocene. Range — Recent — Persian Gulf to Japan, the Philippines down the eastern Australian coast to New South Wales. Pliocene of Java and Miocene of Java and India.

CHARACTERISTIC SPECIES—

Recent — *deshayesii* (Doumet, 1839), *indica* (Deshayes, 1832), *hastula* (Reeve, 1843) (= *trypanodes* Melvill, 1904), *unedo* (Kiener, 1939-40) (= *binda* Garrard, 1961). Pliocene — *bemmeleni* (Oostingh, 1941); *koolhoveni* (Oostingh, 1938); *sondeiana* Martin, 1895). Miocene — *ickei* (Martin, 1906), *haydeni* (Vredenburg, 1925) and *ina* Mac Neil, 1960.

Genus PINGUIGEMMULA Mac Neil, 1960, U.S. Geol. Surv. Prof. Paper 339, p. 103. Type (o.d.) *P. okinavensis* Mac Neil, 1960.

Plate 6, figs. 4, 5

Shell of moderate size, 35-50 mm., broadly fusiform, resembling *Gemmula* in the strongly gemmate sculpture, but with a broadly conical spire coupled with a quickly contracted base and long straight unnotched anterior canal. The sinus is a shallow broadly open "V", its apex on the peripheral carina. Protoconch indicated as probably multispiral. Operculum and radula unknown. The basal spirals frequently develop irregular flutings over the last half whorl as in some species of *Gemmula* and *Ptychosyrinx*. Range — Miocene or Pliocene of Okinawa and Recent from Sumatra to the Philippines in 150-300 fathoms.

CHARACTERISTIC SPECIES—

Miocene or Pliocene — *okinavensis* Mac Neil, 1960. Recent — *luzonica* Powell, 1964; *philippinensis* Powell, 1964; *thielei* (Finlay, 1930) (= *fusiformis* Thiele, 1925).

Genus PTYCHOSYRINX Thiele, 1925,

Gast. Deutsch. Tiefsee-Exped. 17 (2), p. 210. Type (o.d.) *Pleurotoma (Subulata) bisinuata* Martens, 1901. Syn. *Bathybermudia* Haas, 1949, Bull. Inst. Catalana d'Hist. Nat. 37, p. 70. Type (o.d.) *Bathybermudia carynae* Haas, 1949 (*Subulata*, used by Martens, 1901, Sitzungsber. Gesell. nat. Freunde, Berlin, p. 17, as of Anton, 1839, for *bisinuata*, was not introduced by Anton in a nomenclatural sense).

Plate 6, fig. 6

Shell moderately large, 19-53 mm., very similar to *Gemmula*, with its gemmate peripheral carina and tall narrowly conical protoconch of four axially costate whorls but with a shorter more twisted anterior canal, and a different sinus, which is a broadly open V, U-shaped at its apex, not a narrow slit, as in *Gemmula*. Radula, according to Thiele (*bisinuata*; text fig. C55), with, in addition to "wish-bone"-type marginals, a large unicuspid rectangular based central. A feature of the genus is a spout-like labial projection originating from a basal subcarina. This, however, is not a constant feature, even within a species, and is comparable with the condition of multiple flutings of the outer lip, in some species of *Gemmula*. The genus name *Bathybermudia* falls as a synonym to *Ptychosyrinx* since its alleged distinctive character, absence of the "bisinuate" lip, is no longer significant. Range — Recent, the deep ocean basins of the Indian Ocean, Natal, East Africa and the East Indies, the North Atlantic, off Bermuda, 1700 fathoms, and the Pliocene of Timor.

CHARACTERISTIC SPECIES—

Recent — *bisinuata* (Martens, 1901); *carynae* (Haas, 1949); *lobata* (Sowerby, 1903); *timorensis* subsp. *teschi* Powell, 1964; *truncata* (Schepman, 1913). Pliocene — *timorensis* (Tesch, 1915).

Subgenus KUROSHIOTURRIS Shuto, 1961, (of *Ptychosyrinx*),

Mem. Fac. Sci. Kyushu Univ. ser. D, Geol. 11(2), p. 83. Type (o.d.) *Gemmula (Kuroshioturris) hyu-gaensis* Shuto, 1961.

Plate 6, figs. 7, 8

Shell medium sized to moderately large, 12.9-40 mm., very similar to *Ptychosyrinx* in adult facies but with a different protoconch, described as rather large and composed of a depressed, rounded and smooth first volution and a convex and inflated second one, which is smooth, except for the last quarter whorl, with brephic axials. Like *Ptychosyrinx*, there is a tendency toward "bisinuation" of the outer lip in one species, *nipponica*. The disposition of species between *Ptychosyrinx* and the subgenus *Kuroshioturris* is dependant upon knowledge of the protoconch. Therefore some of the species referred to *Ptychosyrinx* may yet prove to be-



long to the subgenus. Range — Upper Miocene and lower Pliocene of Japan, and Miocene of Okinawa.

#### CHARACTERISTIC SPECIES—

*asukana* (Yokoyama, 1926); *hyugaensis* and *nipponica* (Shuto, 1961); *totomiensis* (Makiyama, 1931).

#### Genus CRYPTOGEEMMA Dall, 1918,

Proc. U.S. National Mus. 54 (2238), p. 325. Type (monotypy) *Gemmula benthina* Dall, 1908.

##### Plate 6, fig. 9

Shell small to medium sized, 8-28 mm., broadly fusiform but with a short twisted anterior canal. Weak axial ribs are produced into rounded nodules on a conspicuous peripheral keel. The sinus is at the periphery, rather slight and square-cut at the apex of a broadly open V. Apical whorls unknown. The shell is covered by a greenish-grey periostracum. Operculum oval, with a terminal nucleus. Radula of modified wishbone-type, marginals only, which are long and slender, with the distal limb severed (text figs. B34, 35 & 39). Range — Recent, deep water, 1200-1300 fathoms, Gulf of Panama to Ecuador, and undescribed species from off Hawaii.

#### CHARACTERISTIC SPECIES—

*benthina* (Dall, 1908); *quentinensis* Dall, 1919; *serilla* (Dall, 1908).

#### Genus CARINOTURRIS Bartsch, 1944,

Proc. Biol. Soc. Washington 57, p. 60. Type (o.d.) *Cryptogemma adrastia* Dall, 1919.

##### Plate 6, fig. 10

Shell rather small, 14-16 mm., very similar to *Cryptogemma* in shape but with a plain narrowly rounded peripheral keel. Sinus at the periphery, wide and shallow. Shell white, covered with a pale-olive periostracum. Protoconch of one smooth rounded whorl. Operculum small, broadly ovate, with a terminal nucleus. Radula of wishbone-type, long narrow marginals, with the distal limb severed (text fig. B36). Range — Recent, 300-600 fathoms off California.

#### CHARACTERISTIC SPECIES—

*adrastia* (Dall, 1919); *fortis* Bartsch, 1944); *polycaste* (Dall, 1919).

#### Genus EPIDIRELLA Iredale, 1931,

Rec. Austr. Mus., 18 (4), p. 226. Type (o.d.) *Hemipleurotoma tasmanica* May, 1911. Syn. *Austrogemmula* Laseron, 1954. Type (o.d.) *Hemipleurotoma tasmanica* May, 1911.

##### Plate 6, figs. 11, 12

Shell of moderate size, 26-28 mm., elongate-fusiform, with a bicarinate tall spire and a moderately long almost straight unnotched anterior canal. Protoconch tall of three whorls, first smooth and narrowly dome-shaped, followed by weak oblique axials, crossed on the last whorl by an incipient bicarination. Sinus peripheral, at the upper carina, a shallow broadly open V. Adult sculpture prominently

bicarinate-gemmate, plus a closely spaced pair of subsutural gemmate cords, the sculptural effect on the spire-whorls often being an entire coverage of gemmules. The gemmules in the type of Watson's *xanthophaes* are rather weakly developed but they are much stronger in May's *tasmanica*. These may be taken as the extremes in a variable species. Coloration white, covered by a light horny periostracum. Operculum leaf shaped with a terminal nucleus. Range — The East Australian continental shelf from New South Wales to Tasmania and Victoria. Pliocene — Victoria.

#### CHARACTERISTIC SPECIES—

Recent — *xanthophaes* (Watson, 1886) (= *tasmanica* May, 1911). Lower Pliocene — *sayceana* (Chapman, 1912).

#### Genus FUSITURRIS Thiele, 1929,

Handb. Syst. Weichtierkunde, Jena, 1. p. 361. Type (monotypy) *Pleurotoma undatiruga* Bivona, 1832. Syn. *Tyrrhenoturris* Coen, 1929. Type (s.d.) Powell, 1942) *Pl. undatiruga* Bivona, 1832.

##### Plate 6, fig. 13

Shell of moderate size, 40-50 mm., narrowly fusiform with tall turreted spire and long straight to slightly recurved unnotched anterior canal. Protoconch small, narrowly conic of three smooth whorls. Sinus peripheral, moderately deep and narrowly U-shaped. Operculum leaf-shaped with a terminal nucleus. Radula (text fig. C56), according to Thiele's 1929 figure, a pair of sharp pointed but rather stout marginals, evidently of modified wishbone type, but it is not clear if the base is bifid. Adult sculpture of wavy thin axials crescentically thickened at the narrowly rounded but not keeled periphery. Colour of the type species light brownish with two broad spiral bands of reddish-brown, one occupying the shoulder slope, the other on the base. Range — Recent, Mediterranean and tropical West Africa. Tertiary, Europe, Paleocene to Pliocene. The genus is the European-West African counterpart of the Indo-Pacific *Lophiotoma*.

#### CHARACTERISTIC SPECIES—

Recent — *undatiruga* (Bivona, 1832) (= *balteata* and *corrugata* Kiener, 1839-40 = *similis* Dautzenberg, 1891); *torta* (Dautzenberg, 1912). Pliocene — *porrecta* (Wood, 1848). Miocene — *aquensis* Grateloup, 1832); *inermis* (Hoernes, 1856); *mercati* (Bellardi, 1877); *reevei* (Bellardi, 1847). Oligocene — *conifera* (Edwards, 1861); *difficilis* (Giebel, 1864); *duchastelii* (Nyst, 1836); *explanata* (Koenen, 1890); *flexiplicata* (Kautsky, 1925); *koeneni* Glibert, 1960; *plana* (Giebel, 1864); *selysi* (Koninck, 1837). Eocene — *infraeocaenica* (Cossmann, 1889); *laubrierei* (Cossmann, 1889); *prestwichi* (Edwards, 1861) and *wetherilli* (Edwards, 1861).

#### Genus LUCERAPEX Iredale, 1936,

Rec. Australian Mus. 19, p. 337. Type (o.d.) *Pleurotoma casearia* Hedley & Petterd, 1906.

##### Plate 6, fig. 14

Shell rather small, 13-36 mm., of light build, elongate-fusiform, with a tall spire and a mod-



erately long slightly flexed unnotched anterior canal. The protoconch is small, smooth, paucispiral and globular, ending in up to a quarter whorl of protractively arcuate thin axials. The adult whorls are smooth to weakly lirated, the main sculpture consisting of a peripheral row of scale-like to pointed tubercles, which are either on a simple angulation, or in some species, on a flange-like keel. Sinus peripheral, broadly open, rather shallow, U-shaped and defined over the whole shell in the form of distinct axial growth lines. Colour pattern typically absent; most of the species are pure white, but the New Zealand *angustatus* is maculated in brown. If *angustatus*, which was described as a *Micantapex*, is correctly assigned to *Lucerapex*, then the radula (text fig. C49) is very similar to that of *Lophiotoma acuta*, consisting of a pair of marginals, with the base spread like the jaws of a pair of calipers. Operculum leaf-shaped with a terminal nucleus. Range — Recent; East Africa, Aden to Philippines and down to south-eastern Australia and New Zealand, in deep water, 26-600 fathoms. Miocene; South Australia and Victoria. Quaternary; Timor.

#### CHARACTERISTIC SPECIES—

Recent — *adenica* Powell, 1964; *angustatus* (Powell, 1940); *casearia* (Hedley & Petterd, 1906) and subsp. *regilla* Iredale, 1936; *carola* (Thiele, 1925); "*denticulata*" (Thiele, 1925) (non Smith, 1884); *indagatoris* (Finlay, 1927) (= *optata* Smith, 1899) and *molengraffi* (Tesch, 1915). Quaternary — *molengraffi* (Tesch, 1915). Miocene — *murrayana* (Pritchard, 1904).

#### Genus LOPHIOTOMA Casey, 1904,

Trans. Acad. Sci. St. Louis, 14(5), p. 130. Type (s.d., Woodring, 1928) *Pleurotoma tigrina* Lamarck, 1822=*acuta* Perry, 1811.

##### Plate 6, fig. 15

Shell moderately large, 19-74 mm., narrowly fusiform to biconical, typically with a tall spire and long straight tapered unnotched anterior canal. Protoconch tall, polygyrate, narrowly conical of 3½-4 whorls, strongly sculptured with numerous crisp flexuous axials, crossed by numerous faint spiral threads, which are visible only on the axials, not in the interstices. First 1½ whorls smooth in all examples seen, which are eroded to some extent but the non-eroded protoconch is probably axially costate throughout. Sinus deep and narrow, always on the peripheral keel, which is rim-margined, not on a subsidiary ridge above the periphery as in *Turris*. The adult sculpture is of spiral keels and cords. The operculum is leaf-shaped with a terminal nucleus. The radula (text fig. C43) consists of a pair of modified wishbone-type marginals.

The tooth proper is long and straight, gradually tapered to a sharp point, but the basal limbs spread, like the jaws of a pair of calipers, and are connected by a thin plate (*acuta*). The colour pattern varies from sparsely punctate to tessellate or blotched in brown upon a pale ground. For shells identical with *Lophiotoma* in adult features but with a blunt paucispiral protoconch, see the subgenus *Lophioturris*. The genus is widely distributed over the tropical and subtropical Indo-Pacific and also occurs in the Miocene, Pliocene and Pleistocene of Indonesia. The counterparts of this genus in the tropical Eastern Pacific, the Caribbean and the Tertiary of the south-eastern United States are the genera *Pleuroliria* and *Polystira*.

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#### CHARACTERISTIC SPECIES—

Recent — *acuta* (Perry, 1811) (= *marmorata* Lamarck, 1816, non 1822=*tigrina* Lamarck, 1822=*punctata* Schubert & Wagner, 1829=*peaseana* Dunker, 1871=*jickelii* Weinkauff, 1876=*notata* Sowerby, 1888=*microsticta* Casey, 1904); *albina* (Lamarck, 1822); *abbreviata* (Reeve, 1843) and subsp. *lifuensis* (Sowerby, 1907) and *ustulata* (Reeve, 1846); *ruthveniana* (Melvill, 1923) and *brevicaudata* (Reeve, 1843). Miocene — *albinoides* (Martin, 1883).

#### Subgenus LOPHIOTURRIS Powell, 1964 (of *Lophiotoma*),

Indo-Pacific Mollusca 1(5), p. 311. Type (o.d.) *Turris indica* Röding, 1798.

##### Plate 6, fig. 16

Shell large, 50-91 mm., identical with *Lophiotoma* in adult features but with a different style of protoconch, which is paucispiral, smooth and blunt-tipped. Coloration plain or maculated in brown. Operculum leaf-shaped with a terminal nucleus. Radula (text fig. C44) consisting of a pair of marginals of modified wishbone-type, rather stout medially but tapered to a sharp point above. The whole tooth is rather broadly conical, with a deeply hollowed base, semicircular in cross section (*indica*). Range — Recent, throughout most of the tropical Indo-Pacific. Miocene — Java. Pliocene — Java, Sumatra, Timor, Ceram, North Borneo and the Philippines. Pleistocene — Celebes.

#### CHARACTERISTIC SPECIES—

Recent — *indica* (Röding, 1798) (= *marmorata* Lamarck, 1822, non 1816=*neglecta* Reeve, 1842=*bulowi* Sowerby, 1888 = *gendinganensis* Martin, 1895), *leucotropis* (Adams & Reeve, 1850), *polytropia* (Helbling, 1779) (= *elegans* Wood, 1828 = *fascialis* Lamarck, 1822). Miocene — *pseudofascialis* (Martin, 1883) and *odengensis* (Martin, 1895).

#### Genus OPTOTURRIS Powell, 1944

Rec. Auck. Inst. Mus., 3(1), p. 12. Type (o.d.) *Pleurotoma optata* Harris, 1897.

##### Plate 7, figs. 14-16

Shell rather small, 16-25 mm., elongate-fusiform, with gently rounded whorls, tall spire and moderately long slightly flexed unnotched anterior canal. Protoconch paucispiral of 1½ smooth whorls plus a half-whorl of curved brephic axials. Adult sculpture of weak spiral threads or subcords, and even weaker axials, which are in the form of comma-shaped peripheral crenulations on the

early spire whorls but later become obsolete. The sinus is broadly U-shaped, not very deep and occupies more than half of the shoulder slope, its lower edge at the peripheral subangulation. The genus is characterised by the lack of a peripheral sinus-ridge, gently rounded whorls and weak to subobsolete sculpture. Range — Upper Oligocene of Tasmania, upper Oligocene to Miocene of Victoria and lower Pliocene of Japan.

#### CHARACTERISTIC SPECIES—

Upper Oligocene — *paracantha* (Tenison-Woods, 1877). Miocene — *edita* Powell, 1944 and *optata* (Harris, 1897). Lower Pliocene — *kyushuensis* Shuto, 1961.

#### Genus TURRIS Röding, 1798,

Mus. Boltenianum, 2, p. 123. Type (s.d. Dall, 1909) *Murex babylonus* Gmelin (sic) = *Murex babylonius* Linnaeus, 1758. Syns. *Turris* Muller, 1766 (non binom.), *Pleurotoma* Lamarck, 1799, Mem. Soc. d'Hist. Nat. de Paris, 1, p. 73, no. 26. Type (monotypy) *Murex babylonius* Linnaeus, 1758, *Pleurotoma* Montfort, 1810, Conchyl. Systém, Paris 2, p. 535. Type (monotypy) *Murex babylonius* Linnaeus

#### Plate 6, fig. 17

Shell large, 60-156 mm., elongate-fusiform, with a tall spire and a long straight unnotched anterior canal. Protoconch paucispiral, small, blunt and smooth. Sinus deep and narrow, on a spiral rib immediately above the peripheral carina. Colour pattern usually of spots, tessellations or axial flames in reddish or purplish brown on a pale ground. Operculum leaf-shaped, with a terminal nucleus. Radula (text figs. 40, 41) of wishbone-shaped marginals only, the basal limbs bridged by a flat plate (*babylonia* and *crispa*). Range — Recent — tropical Indo-Pacific, Pliocene of Japan and India, and Miocene of Victoria, Australia.

#### CHARACTERISTIC SPECIES—

Recent = *babylonia* (Linnaeus, 1758) (= *raffrayi* Tapparone-Canefri, 1878 = *venusta* Reeve, 1843), *crispa* (Lamarck, 1816) (= *grandis* Gray, 1833 = *gracillima* Weinkauff, 1875) and subspecies *intricata* Powell, 1964, *variegata* (Kiener, 1839-40) and *yeddoensis* (Jousseaume, 1883), *cryptorrhaphae* (Sowerby, 1825) (= *bicarlinatus* Wood, 1828 = *woodii* Kiener, 1839-40), *garnonsii* (Reeve, 1843), *spectabilis* (Reeve, 1843), and *undosa* (Lamarck, 1816). Pliocene of India — *crispa* (Lamarck, 1816). Miocene of Australia — *selwyni* (Pritchard, 1904) and *septemlirata* (Harris, 1897).

Subgenus ANNULATURRIS Powell, n. subgen. (of *Turris*).

Type: *Pleurotoma amicta* Smith, 1877.

#### Plate 6, fig. 18

Shell large, 45-80 mm., with a tall tapered, rather flat-sided spire and a short, stout, notched anterior canal. Sculpture of heavy spiral ridges separated by narrow interspaces. There is a heavy subsutural margining fold-like spiral, followed by a weaker and narrower concave sinus rib, which is margined, top and bottom, by weak spiral cords. The periphery is gently rounded, not angulated, and the

sinus rib is situated just above the greatest peripheral diameter. Sinus moderately deep, U-shaped. Colour uniformly dull white to dark brownish, without a colour pattern, and typically, covered by an olive-coloured periostracum. Operculum leaf-shaped, with a terminal nucleus. Radula (text fig. C42) consisting of a large well formed central tooth, which has a long slender central cusp, on a broadly rectangular base, that is incurved at the edges, and a pair of marginal teeth of considerably modified wishbone-type. The main element of the marginal is robust ovate-conical, slightly bifid at the base, and this is overlaid by a detached fairly large narrowly ovate member, that seems to have originated from a basal limb of the normal *Turris* marginal. Although the central tooth may be present or absent in the same genus, in *Gemmula* and other members of the Turrinae, the style of marginal in *Annulaturreis* deviates sufficiently from the typical *Turris* wishbone marginal to warrant this subgeneric distinction. So far as the shell is concerned, the truncated *Xenoturreis*-like anterior end, weakly differentiated sinus rib, and lack of a colour pattern serve to indicate the subgenus. Range — Recent, Persian Gulf to Japan and Pliocene of Java and Timor.

#### CHARACTERISTIC SPECIES—

Recent — *amicta* (Smith, 1877) and *annulata* (Reeve, 1843) (= *fagina* Adams & Reeve, 1850). Pliocene — *annulata* (Reeve, 1843).

#### Genus PLEUROLIRIA de Gregorio, 1890,

Monogr. Faune Eocene Alabama, Ann. de Geol. et de Palaeont. Palermo, 7, p. 38. Type (o.d.) *Pleurotoma* (*Pleuroliria*) *supramirifica* de Gregorio, 1890.

#### Plate 6, figs. 20, 21

Very similar to the Miocene-Recent *Polystira*, and evidently the forerunner of it. Smaller than *Polystira*, with a less prominent peripheral keel, and a protoconch of about four whorls, first very small, last 2½ with numerous axial riblets. Range — Eocene and Oligocene of the southeastern United States. This genus and the derived Miocene-Recent Caribbean-Panamic *Polystira* have their parallel in the Indo-Pacific *Lophiotoma*.

#### CHARACTERISTIC SPECIES—

Oligocene — *cochlearis* (Conrad, 1847), *subsimilis* Casey, 1904, *waynensis* Mansfield, 1890. Eocene — *crenulosa* Casey, 1904, *jacksonella* Casey, 1904, *simplex* Casey, 1904, *subdeviata* Gregorio, 1890, *supramirifica* Gregorio, 1890 and *tizis* Gregorio, 1890.

Section JOSEPHINA Gardner, 1945 (of *Pleuroliria*),

Geol. Soc. Amer. Mem. 11, p. 246. Type (o.d.) *Pleuroliria tenagos* Gardner, 1945.

#### Plate 6, fig. 22

Shell moderately large to large, 39-70 mm. The section was proposed "to include those *Pleuroliria* of medium or relatively large dimensions, with protoconchs of four or more whorls



and conchs with spiral cords so prominent that they contour the whorls." Range — The type species is from the Shoal River formation, middle Miocene of Florida, also recorded from the Guajalote formation, lower Miocene of northern Mexico.

The section occupies an apparent transitional position between the Eocene-Oligocene *Pleuroliria*, with its multispiral protoconch and relatively weak spiral keels, and the Miocene — Recent *Polystira*, which has a paucispiral protoconch and prominent spiral keels. However, *tenagos*, by its protoconch is a *Pleuroliria* and there seems to be little justification for recognising an intermediate taxon that relies for its distinction, only upon stronger spiral sculpture, approaching that of *Polystira*.

#### Genus POLYSTIRA Woodring, 1928,

Pub. no. 385 Carnegie Inst. Washington, p. 145. Type (o.d.) *Pleurotoma albida* Perry, 1811. Syn. *Oxytropis* Glibert, 1955, Bull. Inst. Roy. Sci. Nat. Belg., 31, no. 86, p. 5. Type (o.d.) *Pleurotoma oxytropis* Sowerby, 1834.

#### Plate 6, fig. 23

Shell large and solid, 50-110 mm., elongate-fusiform, with a tall spire and a long straight unnotched anterior canal; sculptured with numerous strong smooth spiral keels and cords. Protoconch stout, cylindrical, of almost two whorls, last quarter whorl axially ribbed. Sinus on the peripheral carina, shallow, broadly V-shaped. Colour uniformly white to pale brown, occasionally sparsely punctate in brown. Operculum leaf-shaped, with a terminal nucleus. Radula (text figs. C46-48) of wishbone-type marginals only, which may be entire, the basal limbs connected by a thin plate (*picta*), or one of the basal limbs may be severed (*albida*) and *albicarinata*). Range — Miocene to Recent, Florida, Caribbean, Panama and West Mexico.

#### CHARACTERISTIC SPECIES—

Recent — *albida* (Perry, 1811) (= *virgo* Wood, 1818), *albicarinata* (Sowerby, 1870), *formosissima* (Smith, 1915), *nobilis* (Hinds, 1843), *oxytropis* (Sowerby, 1834), *picta* (Reeve, 1843), *tellea* (Dall, 1889) and *vibex* (Dall, 1889). Pliocene — *panamensis* Olsson, 1942. Miocene — *barretti* (Guppy, 1866).

#### Genus ANTIPLANES Dall, 1902,

Proc. U.S. Nat. Mus. 24, p. 513. Type (o.d.) *Pleurotoma* (*Surcula*) *perversa* Gabb, 1865 (non Philippi, 1847) = *voyi* Gabb, 1866.

#### Plate 7, figs. 2, 3

Shell always sinistral, rather large, up to 55 mm., with a tall narrow spire of rounded whorls and a relatively short strongly flexed anterior canal, with an unnotched termination. Protoconch small, smooth, paucispiral and globular with an asymmetric inrolled tip. Adult sculpture of fine spiral striations; axials obsolete. Shoulder slope scarcely defined. Whole surface covered by a thick periostracum. Sinus moderately deep, broadly open, extending from

the suture to below the periphery, but the actual apex of the sinus is immediately above the greatest peripheral convexity. Operculum leaf-shaped with a terminal nucleus. Radula (text figs. C57, 58) a pair of wishbone-type marginals with the distal basal limb severed, plus a vestigial central tooth.

The genus could be regarded as a benthic Boreal cold-water development from *Turris* or *Fusiturris*, in which a great reduction in sculpture and the acquisition of a thick periostracum has taken place, the latter feature being typical of high latitude shellfish that have to contend with the greater erosive action of ice-diluted sea water.

Range — In the moderate to deep cold waters off the Californian coast to Alaska and around the Bering Sea to Kamchatka and Japan. Also post-Pliocene of California, and claimed from the Lattorfian Oligocene of North Germany (i.e. *perversa* Philippi, 1846, non Gabb, 1865).

#### CHARACTERISTIC SPECIES—

*voyi* (Gabb, 1866); *contraria* Yokoyama, 1928; *kamchatica* Dall, 1919; *major* Bartsch, 1944.

#### Subgenus RECTIPLANES Bartsch, 1944 (of *Antiplanes*),

Proc. Biol. Soc. Washington, 57, p. 59. Type (o.d.) *Pleurotoma* (*Antiplanes*) *santarosana* Dall, 1902. Syn. *Rectisulcus* Habe, 1958, Venus, 20(2), p. 184. Type (o.d.) *Rectiplanes* (*Rectisulcus*) *motojimai* Habe, 1958.

#### Plate 7, fig. 4

The subgenus differs from *Antiplanes* mainly in being dextral instead of sinistral. They average smaller size than the typical genus, 18 - 36 mm., and have a very tall narrow spire, but a truncated base with a relatively short, flexed and weakly notched anterior canal. There is a slightly raised, flat spiral ridge, just above middle whorl height, which marks the rather narrowly rounded apex of the deep U-shaped sinus. Lower outer lip with a distinct insinuation corresponding to a stromboid notch. Protoconch smooth of 1½ somewhat inflated whorls. Adult sculpture of weak sigmoid growth threads crossed by weak irregular transverse wrinkles, and obscure spirals on the base. The whole shell covered with a thick periostracum. Operculum claw-shaped with a terminal nucleus. Radula with a minute vestigial central tooth and a pair of modified "wishbone"-shaped marginals, the distal basal limb severed, and partially superimposed upon the larger member.

Habe's *Rectisulcus* is a dextral shell also, and it seems to differ from *Rectiplanes* only in having more or less well developed spiral sculpture over most of the shell, instead of obscure spirals on the base only. Such a small sculptural difference, however, does not seem to warrant the use of a further subgeneric division. Range — (*Rectiplanes*), Recent, California, Alaska and Japan, 50-150 fathoms,

Pleistocene and upper Tertiary of California and Pliocene of Japan (*Rectisulcus*), Recent and Pliocene of Japan.

CHARACTERISTIC SPECIES—

(*Rectiplanes*) Recent — W. & N.W. AMERICA: *santarosana* (Dall, 1902); *willeiti* Berry, 1953 JAPAN; *sanctioannis* (Smith, 1875) (= *yessoensis* Dall, 1925); *kawamurai* Habe, 1958; Pleistocene and upper Tertiary — N.W. AMERICA; *macfarlandi* Berry, 1947; *muirensis* (Clark & Arnold, 1923) JAPAN; *sanctioannis* (Smith, 1875) (= *sadoensis* Yokoyama, 1926). (*Rectisulcus*); Recent — JAPAN; *isaotakii* and *motojimai* Habe, 1958. Pliocene — JAPAN; *inflatus* (Otuka, 1949); *kazusensis* (Otuka, 1949).

Genus ECHINOTURRIS Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 50. Type (o.d.) *Turris finlayi* Powell, 1935.

Plate 7, fig. 1

Shell small, 8-10 mm., with a tall turreted spire and a moderately long straight unnotched anterior canal. Protoconch blunt, round-topped but cylindrical-sided, of two smooth whorls, ending with a few closely spaced thin axials. The most distinctive features are the bicarinate series of sparse prickly tubercles and the rather deep V-shaped sinus, which is situated on the upper carina. There is possible relationship to *Xenuroturrus*, but if so it is not close. Range — Known only by the type species from the volcanic tuffs at Motutara, west of Auckland, New Zealand; Awamoan, upper Oligocene or Altonian, lower Miocene.

Genus VERUTURRIS Powell, 1944,

Rec. Auck. Inst. Mus., 3(1), p. 9. Type (o.d.) *Xenuroturrus* (*Veruturrus*) *quadricarinatus* Powell, 1944.

Plate 7, fig. 5

Shell of moderate size, 14-58 mm., narrowly fusiform, with a tall spire but a relatively short, not truncated, anterior canal. Protoconch blunt, of 2-2½ smooth whorls followed by a half whorl or so of brephic axials. Sinus deep, broadly V-shaped, on a peripheral cord, or two almost fused cords, situated above middle whorl height. The genus differs from *Xenuroturrus* in its longer unnotched anterior canal and smooth paucispiral protoconch. Range — Oligocene to lower mid Pliocene of Victoria and South Australia.

CHARACTERISTIC SPECIES—

*bisculpta*, *cochleata* and *quadricarinota* (Powell, 1944); *subconcava* (Harris, 1897) and *tomopleuroides* (Powell, 1944).

Subgenus CINGULITURRIS Powell, 1964 (of *Veruturrus*),

Indo-Pacific Moll., 1(5), p. 319. Type (o.d.) *Asthenotoma tatei* Cossmann, 1896.

Plate 7, figs. 6, 7

Shell rather small, 15-22 mm., resembling *Xenuroturrus* in its tall slender spire and truncated anterior end, much shorter than in *Veruturrus*, but differing in the blunt smooth

paucispiral protoconch, followed by a whorl of brephic axials. A feature of the subgenus is the evenly developed strong spiral cinguli, the one bearing the sinus being neither different in size, nor is it margined or duplicate. There is a sculptural resemblance to that of *Turris amicta* (Smith), in which species the sinus rib is similarly undifferentiated. Range — Known only from the Miocene of Victoria, Australia,

Genus XENUROTURRIS Iredale, 1929,

Mem. Queensland Mus., 9(3), p. 285. Type (o.d.) *X. legitima* Iredale, 1929 (= *cingulifera* Lamarck, 1822). Syn. *Clamuturrus* Iredale, 1931, Rec. Austr. Mus. 18(4), p. 226. Type (o.d.) *C. incredula* Iredale, 1931.

Plate 7, fig. 11

Shell moderately large, 25-72 mm., with tall spire but truncated anterior end. Protoconch polygyrate and axially costate. Sinus deep and narrow, at peripheral angle, which is defined by a closely spaced pair of smooth rounded cords. Anterior canal short, distinctly notched. Operculum leaf-shaped with a terminal nucleus. Radula (text fig. C45) of modified wishbone-type, consisting of a pair of marginals only, which are robust, hollow-based conical, tapered to a sharp point (*cingulifera*). They somewhat resemble those of *Unedogemmula*. Coloration usually of tessellations and subsutural or peripheral series of larger maculations in reddish-brown on a paler ground. Except for the truncated anterior end the genus resembles *Lophiotoma*. Range — Indo-Pacific, Red Sea to Natal, to Japan, Hawaiian Islands, Marshall Islands to the Kermadecs and eastern, northern and western Australia.

CHARACTERISTIC SPECIES—

*cingulifera* (Lamarck, 1822) and subsp. *erythraea* (Weinkauff, 1875), *millepunctata* (Sowerby, 1908), *castanella*, *cerithiformis* and *kingae* Powell, 1964 and *incredula* (Iredale, 1931).

Genus VIRIDOTURRIS Powell, 1964,

Indo-Pacific Moll. 1(5), p. 320. Type (o.d.) *Xenuroturrus corona* Laseyron, 1954.

Plate 7, fig. 10

Shell rather small, 15 mm., similar to *Xenuroturrus*, but with a paucispiral dome-shaped protoconch of one smooth whorl, followed by less than one whorl of axial threads. Adult sculpture predominantly spiral, consisting of fine threads on the shoulder slope and anterior end, otherwise strong cords, the heaviest one at the rather sharp peripheral angle, which is below middle whorl height. The whole surface crossed by rather numerous axial lamellae, strongest at the periphery. The sinus is broadly rounded, moderately deep, its apex just above the peripheral carina. Anterior canal short and twisted but unnotched. Range — Known only by the type species, which is from 50-70 fathoms off Green Cape, New South Wales.



Genus EPIDIRONA Iredale, 1931,  
Rec. Austr. Mus. 18(4), p.225. Type (o.d.) *Epidirona  
hedleyi* Iredale, 1931=*striata* auct. (non Gray, 1827).

Plate 7, figs. 8, 9

Shell small to moderate sized, 15-30 mm., with a tall turreted spire but a truncated body-whorl, with a very short shallowly notched anterior canal. It resembles a clavinid in general facies but the sinus is peripheral and there is no entering parietal callus pad. Protoconch small of two smooth turbinate whorls. Sinus moderately deep, narrowly rounded U-shaped, on the peripheral carina. Adult sculpture of strong axials crossed by equally strong to stronger spiral cords and there is a more or less well developed subsutural fold. The peripheral carina bears rounded to compressed nodules and the subsutural fold is usually distinctly crenulated. The outer lip is thin, without a varix, and the interior of the aperture is usually spirally fluted. Operculum leaf-shaped with a terminal nucleus. Radula, marginals only, of modified wishbone-type, the main member broadly conical, with the distal limb severed in *nodulosa* (text fig. B32), and a long slender sinuous overlaid plate in *hedleyi* (text fig. B33). Coloration plain buff to light brown, or weakly tessellated to blotched in darker brown. The genus *Epideira* Hedley, 1918 (Journ. Roy. Soc. N.S.W., 51, p. M79) was intended by its author to cover the above group of shells but Hedley's selection of *Clavatula striata* Gray, 1827 as type, upon the erroneous assumption that it was the common Sydney shell, makes *Epideira* available only for an at present unrecognisable species, probably from Western Australia, and Iredale's *Epidirona* must be used for Hedley's assemblage of species. Range — Recent; New South Wales, Tasmania, southern Australia and Persian Gulf to China Seas. Tertiary; South Australia and Victoria, Miocene to lower mid Pliocene.

#### CHARACTERISTIC SPECIES—

Recent, Australia — *carinata* and *costifera* Laseron, 1954; *flindersi* (Cotton & Godfrey, 1938); *gabensis* (Hedley, 1922); *hedleyi* Iredale, 1931; *jaffaensis* (Verco, 1909); *molleri* and *nodulosa* Laseron, 1954; *perksi* (Verco, 1896); *philipineri* (Tenison-Woods, 1877); *quoyi* Desmoulins, 1842) (= *monile* Kiener, 1839-40); *schoutanica* (May, 1911); *torquata* (Hedley, 1922); *tuberculata* Laseron, 1954. Recent, Indo-Pacific — *multiseriata* (Smith, 1877). Tertiary, South Australia and Victoria — *adelaidensis* (Ludbrook, 1941); *powelli* Ludbrook, 1957; *suppressa* (Finlay, 1927) (= *laevis* Prichard, 1904; non Bell, 1890); *vardoni* (Tate, 1899).

Genus EPIDEIRA Hedley, 1918,

Proc. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Clavatula striata* Gray, 1826.

The type specimen of *striata* Gray, presumed to be from Western Australia, has not been found, nor has any specimen been located that fits Gray's rather undiagnostic description. For the common New South Wales shell identified

as "*striata*" by Hedley (l.c.), Iredale (1931, Rec. Austr. Mus. 18, 4, p. 225) proposed a new genus and species (*Epidirona hedleyi*) claiming that Gray's original species and Hedley's genus, based upon it, are indeterminate so far as our present knowledge is concerned.

Genus TURRIDRUPA Hedley, 1922,

Rec. Aust. Mus., 13(6), p. 226. Type (o.d.) *Pleurotoma acutigemmata* E. A. Smith.

Plate 7, fig. 12

Rather small to moderate sized shells, 12-33 mm., solid, claviform, with a tall spire but a short to truncated anterior canal. Protoconch typically of about three whorls, first two smooth, the last axially costate. Spiral sculpture dominant, one or more of the cords gemmate. A feature of the genus is that one or two spiral threads bisect the shoulder slope. Sinus deep, U-shaped, its apex at the termination of the one or more shoulder slope spirals. Parietal wall without a callus pad or tubercle. Operculum leaf-shaped with a terminal nucleus. Radula with a wide-based unicuspid central tooth and a massive, sharp pointed marginal, which is rather short and broad based, but not bifid (*jubata*). Coloration, usually unicoloured buff to dark brown, but also zoned, banded, tessellated or axially streaked. Range — Recent, tropical Indo-Pacific, Mauritius to Hawaii. Miocene, New Zealand.

The sinus, with its apex just above the periphery, and the lack of a parietal tubercle, suggest the Turrinae as the most likely location for this genus, especially since the possession of a large central tooth in the radula is now shown to be of occasional occurrence in both *Gemmula* and *Turris*.

#### CHARACTERISTIC SPECIES—

Recent — *acutigemmata* (Smith, 1877); *albofasciata* (Smith, 1877) (= *gatchensis* Hervier, 1895); *armillata* (Reeve, 1845); *astriata* (Reeve, 1843) (= *interrupta* Sowerby, 1834); *bijubata* (Reeve, 1843); *cerithina* (Anton, 1839) (= *digitale* Reeve, 1843); *cincta* (Lamarck, 1822); *deceptrix* Hedley, 1922; *jubata* (Hinds, 1843); nom. nov. (ms.) (= *rimata* Preston, 1908. Miocene — New Zealand: *maoria* Powell, 1942.

Genus AUSTROTURRIS Laseron, 1954,

Zool. Handb. Roy. Zool. Soc. N.S.W., p. 6. Type (o.d.) *Filodrillia steira* Hedley, 1922.

Plate 7, fig. 13

Shell small, 5.8 mm., probably related to *Turridrupa*. Claviform, with a tall spire but a relatively short anterior canal and a protoconch of only two smooth whorls. Sinus wide and deep, narrowed apically to just above the peripheral keel. Shoulder slope conspicuously sculptured with numerous arcuate axial riblets. Range — Known only by the type species, which is from off New South Wales in 30-50 fathoms.



### Genus TARANIS Jeffreys, 1870,

Ann. Mag. Nat. Hist. ser. 4(5), p. 447. Type (monotypy) *Trophon mörchi* Malm, 1863. Syns. *Fenestrosyrinx* Finlay, 1926, Trans. N.Z. Inst. 56, p. 254. Type (o.d.) *Turris nexilis bicarinatus* Suter, 1915. *Allo* (Jousseume ms.) Lamy, 1934. Type (o.d.) *Allo allo* (Jousseume ms.) Lamy, 1934 and *Feliciella* Lamy, 1934. Type (o.d.) *Feliciella jousseumei* Lamy, 1934 (unnecessary substitutes for *Allo allo*), Journ. de Conch. 78, pp. 67-71.

#### Plate 7, fig. 18

Shell very small, 2.5 - 6 mm., ovate-biconic, like a miniature *Bathytoma*, predominantly medially angulate and spirally keeled, usually crossed by lamellate axials, which produce a fenestrate sculptural pattern. Protoconch paucispiral, of barely two whorls, papillate to slightly globose, superficially smooth, but with a microscopic sculpture of closely spaced stippled spiral lirae. Sinus shallow, its apex at the peripheral angle or major keel, and with unequal angles of approach, being steep and straight above, but protractively arcuate below. The pillar is abruptly twisted at the beginning of a short shallowly notched anterior canal. No colour pattern, white or translucent. Operculum absent in the type species. The subfamily location of *Taranis* is at present problematic, but solely upon the style of sinus, the apex of which is peripheral, the genus is provisionally located in the Turridae. On the other hand the steeply descending and straight, upper slope of the sinus, recalls that of some species of *Pleurotomella*, so the Daphnellinae may yet prove to be a more satisfactory location. Range — Recent, North Atlantic, in deep water, Norway to the Mediterranean and Atlantic coast of North America, Red Sea to the Philippines, Japan, eastern and southern Australia and New Zealand. Pleistocene of England, Sicily, California and New Zealand and the Pliocene of Italy. Probably many other species, both Recent and fossil may later be admitted to this wide ranging genus.

#### CHARACTERISTIC SPECIES—

Recent — NORTH ATLANTIC; *mörchi* (Malm, 1863); RED SEA and INDO-PACIFIC; *allo* (Lamy, 1934) (= *jousseumei* Lamy, 1934); n.spp. Powell (ms.): *turritispira* (Smith, 1882); SOUTH AUSTRALIA; *mayi* (Verco, 1909); NEW ZEALAND; *benthicola* (Dell, 1956); *bicarinata* (Suter, 1915); *gratiosa* (Suter, 1908); *imporcata* (Dell, 1962); *nexilis* subsp. *recens* (Fleming, 1948); *spirulata* (Dell, 1962). Pleistocene — NEW ZEALAND; *bicarinata* (Suter, 1915); *nexilis* (Hutton, 1885).

Genus MICROPLEUROTOMA Thiele, 1929, Handb. Syst. Weichtierkunde, 1, p. 362. Type (o.d.) *Pleurotoma spirotropoides* Thiele, 1925.

#### Plate 7, fig. 17

The type species is a small shell, 4.5 mm., and rather featureless. Protoconch relatively large, globose to dome-shaped, smooth and paucispiral. Adult whorls smooth except for a prominent, smooth, rounded peripheral keel. Sinus shallow, its apex on the peripheral keel.

Anterior canal short, spout-like and unnotched. Range — Recent: *spirotropoides* (Thiele, 1925), South Africa, Agulhas Bank in 2750 metres. Upper Oligocene: *ashiyaensis* Shuto & Ueda, 1963, near Taya, Japan. It is doubtful if this imperfectly preserved fossil, of relatively large size, 23.4 mm., is really related to the Recent type species.

### Subfamily CLAVATULINAE H. & A. Adams, 1858

Members of this subfamily are moderate sized, usually very stout shells of quite variable form, ranging from typical *Clavatula*, which is of buccinoid facies, strongly sculptured, even spinose, to the slender truncated based *Clionella*, a shell that closely simulates some clavinids.

A feature these shells have in common is an ovate operculum with a medio-lateral nucleus. Typical *Turricula* also has this style of operculum, but the Clavatulinae are distinguished more by their form of shell growth, in that the suture is noticeably adpressed, resulting in each whorl rising high upon the preceding one.

The sinus in the Clavatulinae is situated upon the shoulder slope and varies between a broad shallow indentation to one of moderate depth, with a narrow U-shaped apex.

In one genus, *Pusionella*, there is a striking resemblance to *Terebra*, in that the whorls are smooth, polished and lightly convex, the sinus is slight, and the colour pattern is of dark rectangular blotches, a factor which also simulates that of some terebrids. It is likely that the terebrids had a common ancestry with this subfamily.

The radula of the Clavatulinae consists of a pair of massive broadly conical to ovate marginals of modified wishbone-type, with the distal basal limb, partially or wholly detached, and the central may be absent, vestigial, or moderately well developed. In Thiele's drawings of the clavatulid radula (1925, Gast. Deutsch. Tiefsee-Exped., 17, 2, p. 204) the central tooth is shown as unicuspid upon a small narrow rectangular plate, but with staining Mr Winston Ponder has revealed that in *Clionella*, at least, the rectangular base has a broad lateral extension, in the form of a very thin rectangular plate.

An aberrant derivation from *Clionella*, represented by the species *tumida* (Sowerby) is segregated subgenerically on account of its fully developed toxoglossate dentition, in which the slender, barbed, arrow-like teeth, in association with the neurotoxic apparatus, lie loose in the radula sac, and may be shot, harpoon wise into their victim. The ability to develop this highly specialised use of the radula for predaceous purposes is apparently inherent in all the subfamily groups of the Turridae to a varying extent, and emphasises the close rela-



tionship of the family with the Conidae, in which the fully developed toxoglossate dentition is general.

The subfamily was abundantly represented in Europe from the Oligocene to the Pliocene, and if the genera *Trachelochetus* and *Pyrenoturris* are correctly assigned to it, then the Clavatulinae extends back to the Eocene of Europe and Pakistan. Today, however, the subfamily is restricted to the western coastline of Africa, from the Mediterranean to South Africa.

#### Genus CLAVATULA, Lamarck, 1801,

Syst. Anim. sans Vert., p. 84. Type (monotypy) *Clavatula coronata* Lamarck, 1801.

##### Plate 8, fig. 1

Shell moderately large to large sized, 15 - 55 mm., very solid, buccinoid, coarsely axially and spirally sculptured; with a tall, often coronated spire, and a truncated body-whorl, terminated in a relatively short reflected and deeply notched anterior canal, which is backed by a prominent ridge-margined fasciole, encircling a false umbilical cavity that can be quite wide. Protoconch relatively small of 2-3 smooth whorls. Adult sculpture of strong but irregular spiral cords which may be smooth or granose, often produced into nodules or pointed up-curved spines in a subsutural and peripheral series. The suture, typically, is at the top of a wide broadly rounded fold which clasps high on the preceding whorl and half envelopes the peripheral carina. Colour dull white, with obscure brownish to dark brown streaks, usually covered by a dark olive periostracum. Operculum ovate-lunate with a medio-lateral nucleus. Radula (text figs. C60-62) consisting of a pair of stout but narrowly pointed marginals of modified wishbone type, the proximal extremity of the base separated and superimposed upon the larger element. A small but well formed unicuspid central tooth is present also. Range — Recent, West Africa, Pliocene of north Italy, Miocene of France, Austria and Italy and Oligocene of North Germany.

##### CHARACTERISTIC SPECIES—

Recent — *bimarginata* (Lamarck, 1822), *caerulea* (Weinkauff, 1875), *colini* Maltzan, 1883, *decorata* Sowerby, 1916, *gabonensis* Melvill, 1923, *lelieuri* (Recluz, 1851), *martensi* Maltzan, 1883, *muricata* (Lamarck, 1822) (= *diadema* Kiener, 1839-40), *mystica* (Reeve, 1843) (= *sacerdos* Reeve, 1845), *rubrifasciata* (Reeve, 1845), *strebli* Knudsen, 1952. Pliocene — *interrupta* (Brocchi, 1814). Miocene — *asperulata* (Lamarck, 1822), *calcarata* (Grateloup, 1832), *granulatacineta* and *schreibersi* (Hoernes, 1856), *spinosa* (Grateloup, 1832). Oligocene — *semi-laavis* (Philippi, 1846).

#### Genus PERRONA Schumacher, 1817,

Ess. Vers test. 66, p. 218. Type (monotypy) *Perrona tritonium* Schumacher, 1817 = *Murex perron* Gmelin, 1790 = *Pleurotoma perronii* Reeve, 1843.

##### Plate 8, fig. 2

Shell moderately large, 25 - 40 mm., rather

narrowly fusiform, with a tall spire of rapidly increasing whorls, and a narrow body-whorl, tapered to a rather long slightly flexed and recurved weakly notched anterior canal. Surface smooth, or nearly so, covered by a thin olive periostracum, and with a conspicuous narrowly carinated subsutural collar, as well as a broadly rounded basal angulation, which gives a biangulate appearance to the body-whorl. Sinus moderately deep, narrowly rounded at its apex, but with widely divergent angles of approach, the apex situated nearer to the subsutural than to the basal keel. Colour pale brownish often irregularly axially streaked in reddish brown. Operculum as in *Clavatula*, ovate-lunate, with a medio-lateral nucleus. Radula consisting of an elongated sharply pointed pair of marginals, bifurcate at the base, and a narrow-based unicuspid central tooth. The radula is nearer to that of *Clionella* than to that of *Clavatula*. Range — Recent, West Africa and Miocene of North Europe the Mediterranean and Morocco, Burma and Sumatra.

##### CHARACTERISTIC SPECIES—

Recent — *obesa* (Reeve, 1843), *perron* (Gmelin, 1791) (= *perroni* Reeve, 1843), *spirata* (Lamarck, 1816). Miocene — EUROPE, *carinifera* (Grateloup, 1832), *detecta* (Desmoulins, 1842), *hemmoorensis* Kautsky, 1925), *jouanneti* (Desmoulins, 1842), *semi-marginata* (Lamarck, 1822), *vulgatissima* (Grateloup, 1832). BURMA, *birmanica* Vredenburg, 1921. SUMATRA, *erbi* (Haanstra & Spiker, 1932).

#### Subgenus TOMELLANA Wenz, 1943 (of *Perrona*),

Handb. der Paläozool. 6, 1, 6, p. 1383. Nom. nov. pro *Tomella* Swainson, 1840, Treat. Malac. pp. 155, 314 (non Robineau-Desvoidy, 1830). Type (s.d. Herrmannsen, 1849) *Pleurotoma lineata* Lamarck, 1816.

##### Plate 8, fig. 3

This apparently monotypic subgenus differs from *Perrona* in its short, concavely outlined spire, massive peripheral fold, lack of a basal angulation, very heavy parietal callus pad, and deep slit-like anal sinus. Protoconch small, papillate, of 1½ smooth whorls, followed by a whorl of sigmoid brephic axials. Coloration most distinctive, consisting of numerous narrow dark-brown axial lines on a cream coloured ground. The lines are chevroned in the region of the sinus fasciole, which is in the form of a very shallow groove, situated well below the massive peripheral fold. The anal fasciole does not show on the spire whorls, being immersed by each succeeding whorl. Parietal callus pad white, very massive. Radula (text fig. C63) with a small narrow-based unicuspid central and a pair of large long simple pointed marginals, with one of the basal limbs detached and overlaid. Range — Known only by the type species, which is Recent from West Africa.

#### Genus CLIONELLA Gray, 1847,

Proc. Zool. Soc. pt. 15, p. 153. Type (o.d.) *Buccinum sinuatum* Born, 1778.



## Plate 8, fig. 4

Shell moderately sized to large, 25 - 60 mm., claviform to terebriform, with a tall rather flat-sided spire, and a truncated body-whorl, terminated in a slightly twisted short anterior canal, which is deeply notched, and is backed by a prominent ridge-margined fasciole. Sculpture of prominent long flexuous narrow axials, chevroned at the ridge-margined posterior fasciole which is situated at the lower edge of a shallow shoulder slope. Aperture narrowly ovate; outer lip thin, with a shallow narrowly U-shaped sinus at the termination of the posterior fasciole. A broad shallow insinuation, scarcely a stromboid notch, is situated towards the anterior end. Shell white to pink, usually with a rather thick olivaceous to dark brownish periostracum. Operculum ovate, slightly narrowed below, with a lateral nucleus, situated at about a third way up from the lower or anterior end. Cephalic tentacles short, cylindrical, with the eye ledged on the distal side, at a short distance below the conical point. Radula consisting of a pair of stout but narrowly pointed marginals, their bases bifurcate, and an apparently small narrow unicuspid central tooth, *sinuata* (Thiele, 1925; text fig. C67), but in the subspecies *sigillata* (text fig. C66), staining has revealed that the central tooth has a broad but indistinct rectangular basal plate. The radula more closely resembles that of *Perrona* (*Tomellana*) *lineata* than that of *Clavatula* (*rubrifasciata*). Range — Recent, South and South West Africa.

The genus differs from *Clavatula* in its claviform shape, with tall flat-sided spire whorls, simple long flexuous axials, without either subsutural or peripheral processes, and truncated body-whorl. The subsutural fold is slight, and the sinus is a weak narrow and shallow U. The more closely related *Perrona* is smooth surfaced, or nearly so, with a biangulate body-whorl, a longer canal, and the sinus, although slight and U-shaped, is at the apex of a wide shallow chevroned insinuation.

## CHARACTERISTIC SPECIES—

*bipartita* (Smith, 1877), *bornii* (Smith, 1877), *confusa* Smith, 1906, *nercia* Bartsch, 1915, *sinuata* (Born, 1778) (= *buccinoides* Lamarck, 1822), *turriplana* (Sowerby, 1903).

Subgenus TOXICLIONELLA Powell, n. subgen. (of *Clionella*).

Type: *Clavatula tumida* Sowerby, 1870.

## Plate 8, figs. 5, 6

This large South African species, which has all the external features of *Clionella*, and has a similar clavatulid operculum, differs markedly in its radula (False Bay, South Africa; text fig. C68), which is truly toxoglossate, consisting of a bundle of long slender curved marginals, double barbed near the tip. The normal *Clionella* radula has massive modified

wishbone-shaped marginals and a unicuspid central, with a large laterally spreading rectangular base, but this feature is indistinct and revealed only by staining.

Barnard (1958, Ann. S. African Mus., 44, p. 111) noted the aberrant double barbed-arrow teeth of this species also, but referred it, with a query, to the genus *Clavatula*, segregating it from the true clavatulids and placing it in Thiele's subfamily Brachytominae, which equals my Clavinae.

Shell large, 55-60 mm., claviform, with a tall spire of flattened outlines and a rather narrow body-whorl, terminating in a short rather widely open and shallowly notched anterior canal. Colour dull white under an olive-brown periostracum. Protoconch unknown. Spire whorls with a heavy subsutural fold, followed by a rather narrow but moderately deep shoulder sulcus. Sculpture of numerous flexuous axial folds which are nodular on the subsutural fold, chevroned over the shoulder sulcus and protractively arcuate below the sulcus. Weak spiral striations encircle the anterior end. Outer lip thin, with a shallow U-shaped sinus at the termination of the shoulder sulcus, and a very weak stromboid notch below. Range — South Africa in 25-55 fathoms.

## Genus PUSIONELLA Gray, 1847,

Proc. Zool. Soc. pt. 15, p. 137. Type (o.d.) *Murex pusio* Born, 1778=*Buccinum nifat* Bruguière, 1792. Syn. *Netrum* Philippi, 1850, Abb. u. Besch. Conchyl. p. 118. Types *Fusus nifat* (Adanson) Bruguière, 1792.

## Plate 8, figs. 7, 8

Shell rather large, 35-40 mm., subfusiform, with a moderately tall spire of rather flat-sided whorls, a long narrow body-whorl, considerably excavated over the neck, and produced below into a moderately long slightly flexed and deeply notched anterior canal, with a ridge-margined fasciole. Aperture narrowly ovate-pyriform; outer lip thin edged, sinuous, with a broad subsutural very slight sinus, a very widely open V, its apex above the greatest peripheral convexity. There is a rather heavy parietal callus pad at the termination of the suture. Protoconch conical, apparently smooth and of several whorls. Early post-embryonic whorls closely axially costate, remainder smooth and polished. The suture is submargined by a broad low inconspicuous fold. The type species is maculated with revolving series of reddish-brown rectangular spots upon a buff to yellowish-brown ground. The type species has the appearance of a *Terebra* with a much shortened spire. Operculum ovate, with a medio-lateral nucleus. Radula (text figs. C64, 65) consisting of a pair of stout marginals of modified wishbone-type, the distal limb of the base separated and of reduced size. Range — Recent, North Africa to West Africa and Miocene of France.



## CHARACTERISTIC SPECIES—

Recent — *aculeiformis* (Lamarck, 1822), *haasi* Dautzenberg, 1912, *nifat* (Bruguière, 1792), *subgranulata* (Petit de la Saussaye, 1851), *vulpina* (Born, 1780) (= *buccinatus* Lamarck, 1822). Miocene — *pseudofusus* (Desmoulin, 1842).

## Genus TRACHELOCHETUS Cossmann, 1889,

Ann. Soc. Malac. Belg. 24, p. 250. Type (o.d.) *Pleurotoma desmia* Edwards, 1856.

## Plate 7, figs. 21, 22

Shell of moderate size, 16-22 mm., rather broadly fusiform, with a tall spire and a rather long body-whorl, deeply excavated over the neck and produced into a relatively long straight unnotched anterior canal. Protoconch broadly conical of 2-3 smooth whorls. Adult sculpture of flexuous axials, overridden by crisp spiral cords and threads. Firstly there is a broad rounded subsutural fold that clasps high on the preceeding whorl and is finely lirate and crenulated by axials; followed by a rather broad and moderately deep shoulder sulcus, sculptured with fine spiral threads, crossed by numerous growth lines, which follow the outline of the U-shaped sinus. Two or three cords at the peripheral angle are vertically fused, and below this, including the base, all the primary spirals are nodulose to some extent. The aperture is small and narrowly ovate, quickly contracted to the long narrow anterior canal. Outer lip thin edged but strongly spirally lirate within. Inner lip callus smooth, a thin layer of callus, sometimes slightly excavated. Range — Bartonian and Auversian Eocene of England and France.

The genus resembles *Clavatula*, with its high clasping subsutural fold but differs in the long straight unnotched anterior canal, and also in the strong lirations within the outer lip.

## CHARACTERISTIC SPECIES—

*desmia* and *microdonta* (Edwards, 1856).

## Genus PYRENOTURRIS Eames, 1952,

Phil. Trans. Roy. Soc., ser. B, 236, p. 133. Type (o.d.) *Pyrenoturris soriensis* Eames, 1952.

## Plate 7, figs. 19, 20

The genus is based upon imperfect material, representative of two species; there being no knowledge of either the protoconch or the form of the aperture. Following is the original description and remarks. Shell "Subfusiform, with conic spire; whorls stepped, with a circum-sutural band, with axial and spiral ornament developing beads or crenulations, especially on the posterior part of the whorls where they tend to be scabrous, and where the ribs tend to be foliaceous; base excavated; growth lines gently to moderately convex anteriorly, with a distinct U-shaped sinus posteriorly, antecurrent at the suture. Remarks. This genus is provisionally placed in the subfamily Cytharinae on the basis of its general appearance, pending

the discovery of specimens exhibiting the characters of the aperture". The incomplete material ranges between 12 and 18 mm. in height. Range — known by two species from the lower Eocene of Pakistan — *punjabensis* and *soriensis* Eames, 1952.

There seems to be little if any justification for considering this genus to belong to the Cytharinae (=Mangeliinae). A much more likely relationship would seem to be near to the clavatulid genus *Trachelochetus* of the English Bartonian Eocene.

## Subfamily BORSONIINAE Bellardi, 1875

In its present coverage this subfamily includes some diverse elements, that later, may be either segregated or relegated to other subfamilies.

The main diagnostic feature of the borsonids is the presence of pillar plaits, that are often strongly developed. Typically the shell is elongate-fusiform, but it often simulates other groups such as the Turrinae, Turriculinae, Clavinae, and even the Mitridae. They range in size from up to 85 mm. for *Bathytoma*, 44 mm. for *Borsonia*, and down to 3-8 mm. for most of the mitromorphid genera.

The radula consists of a pair of marginals only, which are slender, slightly curved, minutely barbed at the tip, and broadly expanded basally. This is the style of radula found in *Borsonia ochracea* Thiele and *Scrinium neozelanica* (Suter). Similarly shaped, but non-barbed marginals characterise *Borsonella*, *Bathytoma* (*Riuguhdrillia*), *B. (Paraborsonia)* and *B. (Micantapex)*. On the other hand the mitromorphid genera have simple straight slender marginals that are laterally constricted toward the tip, but not barbed, and the base is broadly expanded.

The laterally constricted tip of the mitromorphid radula closely resembles the "candle-flame" termination of the typical daphnellid radula, but neither the reversed L-shape sinus nor the "sinusigerid" protoconch of *Daphnella* is found in the mitromorphid group.

The borsonids are widely distributed, and represented back to as far as the Paleocene. Their greatest development was in the Eocene and Oligocene; Recent species are found in most seas, but are comparatively few in number.

## Genus BORSONIA Bellardi, 1839,

Bull. Soc. géol. France, 10, p. 30. Type (monotypy) *Borsonia prima* Bellardi, 1839.

## Plate 8, figs. 9, 10

Shell of small, moderate, or rather large size, 7-44 mm., elongate-fusiform, usually with angulated whorls, rather distant strong axials, and typically, one, sometimes two distinct plications about the middle of the pillar. Protoconch small, conoidal of about 1½ smooth whorls.



Aperture narrowly pyriform, ending in a rather short slightly flexed unnotched spout-like anterior canal. Outer lip thin edged, with a broadly rounded moderately deep sinus occupying the whole of the shoulder slope, and accentuated in depth by an arcuate forward projection of the lower part of the lip. Radula (*ochracea*; text fig. E113), a pair of slender slightly curved marginals, slightly barbed at the tip, and broadly expanded basally. Range — Paleocene to Pliocene of Europe, Oligocene to Pliocene of England, Oligocene of Mexico, Oligocene and Miocene of Australia, Oligocene to Pliocene of Indonesia, Okinawa and Japan. Recent from East Africa, 1644 metres, East Indies, 900-960 metres, South Australia, 300 fathoms, Caribbean and off Brazil, 350-390 fathoms.

The separation of borsonid genera solely upon the basis of the number of pillar plaits can be deceptive, for although *Borsonia*, typically, has one plait and *Cordieria* two, there may be a second and even a rudimentary third plait in otherwise typical *Borsonia*.

A better criterion is the shell shape, which is elongate-pyriform, with a tall spire, and an excavated neck to a relatively long anterior canal, resembling *Turricula*, for *Borsonia*, and a more ovate-fusiform or biconic-fusiform shape for *Cordieria*, usually with only a slight neck and a rather short anterior canal. Also the sinus is relatively deep in *Borsonia*, but wide and shallow in *Cordieria*.

Still more puzzling are the claviform species, such as *timorensis* Schepman, 1913, that exhibit a single well formed pillar plait. Until the significance of pillar plaits is properly understood, all species exhibiting distinct pillar plaits are considered to belong to the Borsoniinae, but admittedly such a grouping is not necessarily morphologically sound.

#### CHARACTERISTIC SPECIES—

Paleocene (Europe) — *coemansi* Briart & Cornet, 1871. Eocene (Europe) — *bairitziana* and *pyrenaica* (Rouault, 1850), (New Zealand) — *zelandica* (Marshall, 1919). Oligocene (Peru) — *peruviana* Olsson, 1931, (Mexico) — *aguilae* Cooke, 1928, (Australia) — *balteata*, *otwayensis*, *polycesta* and *protensa* Tate, 1898, *tatei* and *torquayensis* Powell, 1944, (New Zealand) — *mitromorphoides* (Suter, 1917). Miocene (Europe) — *burdigalena* Benoist, 1873, *prima* Bellardi, 1839, *rouaulti* Bellardi, 1877, *uniplicata* Koenen, 1872 (Indonesia) — *granifera* H. Woodward, 1879, *rembangensis* Pannekoek, 1936, (Okinawa) — *shimajiriensis* Mac Neil, 1960, (New Zealand) — *clifdenensis* Finlay, 1930. Pliocene (England) — *suffolciensis* Harmer, 1915, (Timor) — *indica* (Tesch, 1915), *marci* Koperberg, 1930, (Japan) — *miyazakiensis* and *smithi* subsp. *hagenoshita* Shuto, 1961. Recent (Caribbean) — *ceroplasta* Watson, 1886, (Brazil) — *silicea* (Watson, 1881), (Indonesia) — *epigona* Martens, 1901, *smithi* Schepman, 1913, (East Africa) — *ochracea* Thiele, 1925, (South Australia) — *jaffa* Cotton, 1947.

Subgenus BOETTGERIOLA Wenz, 1943 (of *Borsonia*),

Handb. Palaeozool. 6, 1, p. 1424; nom. nov. pro

*Boettgeria* Peyrot, 1932 (non Boettger, 1863). Type (o.d.) *Borsonia* (*Boettgeria*) *gallica* Peyrot, 1932.

#### Plate 8, fig. 11

The subgenus *Boettgeriola* differs from typical *Borsonia* only in its narrowly fusiform shape of lightly convex, weakly angulate, but otherwise smooth whorls, with the weak single inner-lip plication situated high up on the parietal wall. The body-whorl is long and narrow, gradually tapered to a long spout-like unnotched anterior canal. The shell is moderately large, 17-45 mm. Range — Known by two species, both from the Aquitanian Miocene of France.

#### CHARACTERISTIC SPECIES—

*degrangei* and *gallica* Peyrot, 1932.

#### Genus CORDIERIA Rouault, 1848,

Bull. Soc. géol. France, 2, 5, p. 207. Type (s.d. Cossmann, 1896) *Cordieria iberica* Rouault, 1850. Syns. *Phlyctaenia* Cossmann, 1889, Ann. Soc. malac. Belg. 24, p. 241. Type (o.d.) *Pleurotoma nodularis* Deshayes, 1834 (non Huebner, 1825). *Phlyctis* Harris & Burrows, 1891, nom. nov. pro *Phlyctaenia* Cossmann, 1889, Eoc. Olig. Beds Paris Basin, 96, p. 113. ?*Liticoconcha* Gregorio, 1880 Fauna S. Giov. Ilarione, 1, p. 61.\*

#### Plate 8, fig. 12

Shell small to moderate sized, 8-19 mm., ovate-fusiform, with a tall conical spire of lightly convex whorls, weakly to moderately angulated at above middle whorl height. Body-whorl elongate-ovate, very little excavated over the neck and terminated in a short unnotched anterior canal. Protoconch small, conoidal to mamillate, of 1½-2 smooth whorls. Adult sculpture of broad axial folds overridden by rather dense spiral lirations. Outer lip thin edged, with a wide shallowly arcuate subsutural sinus. Pillar with two medially placed, closely spaced, well developed oblique plaits. Range — Paleocene to Pliocene of Europe, Eocene of the southern United States, California and New Zealand, and Recent, Caribbean, 76-103 fathoms.

#### CHARACTERISTIC SPECIES—

Paleocene (European) — *binodosa* (Koenen, 1885), Eocene (European) — *acutata* (Deshayes, 1865), *baccata* (Cossmann & Pissarro, 1900), *bellardii* (Deshayes, 1865) *biplicata* (Sowerby, 1850), *brevicula* (Deshayes, 1834), *bureaui* (Cossmann 1919), *calliphlyctis* (Cossmann & Pissarro, 1900), *calvimontana* (Deshayes, 1865), *chevallieri* (Cossmann, 1889), *cresnei* (Raincourt, 1884), *douvillei* (Cossmann & Pissarro, 1900), *dumasi* (Cossmann, 1896), *edwardsi* (Deshayes, 1865), *iberica* Rouault, 1850, *incerta* Deshayes, 1865, *ischnocolpa* (Cossmann & Pissarro, 1900), *lineata* (Edwards, 1861), *marginata*, *minor* and *mitraeformis* (Deshayes, 1865), *nodularis* (Deshayes, 1834), *obesula* (Deshayes, 1865), *obtusica*, *oppenheimi* and *punctolirata* (Cossmann & Pissarro, 1900), *sulcata* (Morris, 1856), *turbinelloides* (Deshayes, 1865), *variolata* (Cossmann & Pissarro, 1900), (S.E. United States) — *biconica* (Whitfield, 1865) and subspp. *curta* and *newtonensis* Harris, 1937, *ludoviciana* (Vaughan, 1896) and subsp. *mississippiensis* Harris, 1937, (California) — *gracillima* Cooper, 1894, (New Zealand) — *haasti* and *huttoni* Finlay, 1930, *rudis* (Hutton, 1885), *verrucosa* Finlay, 1930. Oligocene (European) — *gracilis* (Sandberger, 1862),



*plicata* (Beyrich, 1848), *turris* (Giebel, 1865), *delucii* (Nyst, 1836), *vicentina* Degl'Innocenti, 1928. Recent (Caribbean) — *rouaultii* Dall, 1889.

For biplicate broadly biconical shells of *Bathytoma* — like facies, see *Paraborsonia* Pilsbry, 1922.

\* I have not been able to refer to Gregorio's paper, so can offer no comments upon *Licticoncha* at this stage. It was included in the synonymy of *Cordieria* Rouault, by Wenz (1943, Handb. der Pal. 6, p. 1424).

Genus **PLEUROPYRAMIS** Vredenburg, 1921,

Rec. Geol. Surv. India 53(2), p.126. Type (o.d.) *Mangilia* (*Clathurella*) *quinqueangularis* Vredenburg, 1921.

*Plate 8, fig. 13*

Shell of moderate size, 23 mm., claviform, with a tall lightly convex whorled spire, and a subglobose body-whorl, rather quickly contracted to a moderately long anterior canal. Protoconch small, conical, consisting of an obtusely rounded apex followed by three whorls of fine concave protractive riblets. Sinus band a flat slightly sunken area, its lower extremity defined by a weakly incised spiral line. Adult sculpture of distant broadly rounded axials, five per whorl, in line from whorl to whorl, except for the last, where they are broader and only four in number. Spiral sculpture obsolete, surface smooth except for delicate growth lines. The sinus is broad and deep, on the sunken shoulder slope. Outer lip broken away; inner lip rather broad with a defined edge, callused over the parietal area; at about mid height there is a rather obscure oblique fold with a weaker one immediately below it. Range — Known only by the type species which is from the Kama Stage, Aquitanian Miocene of Burma.

The systematic position of the genus is problematic, the style of ribbing, continuously in line from whorl to whorl, suggests the clavinid genus *Plagiostropha*, but the twin columellar folds, although slight, suggest more likely relationship with the borsonid genus *Cordieria*.

Vredenburg made this shell type of a new section of *Clathurella* (i.e. *Philbertia*) but there is no connection with that daphnellid genus.

Genus **BORSONELLA** Dall, 1908,

Bull. Mus. Comp. Zool. 43, 6, p. 258. Type (o.d.) *Pleurotoma* (*Borsonia*) *dalli* Arnold, 1903.

*Plate 8, fig. 14*

Shell of rather small to medium size, 12-29 mm., fusiform-biconic, with a tall spire of bluntly angulated whorls, and an ovate body-whorl, slightly excavated over the neck and produced into a rather short, slightly flexed and recurved, unnotched anterior canal. Protoconch small, bluntly rounded of one or two smooth whorls. Adult whorls with a rather wide concave and sunken shoulder slope, followed by a

broadly rounded peripheral fold, which may be smooth or with weak oblique folds or beads. Surface smooth to weakly spirally liriate, usually on the base only; the whole shell covered by a smooth light-olive coloured periostracum. Aperture pyriform; outer lip thin. Sinus deep, broadly U-shaped, occupying the whole of the shoulder sulcus; below, the lip is arcuately produced. Inner lip smooth callused, with a single, median placed, nearly horizontal, strong plait. Operculum absent (Dall, l.c., p. 258). Radula (text figs. E114-117) consisting of a pair of long slender, almost straight to considerably flexed narrow simple pointed marginals with a slightly expanded base. Range — Recent California to Panama, 30-1471 fathoms. Pleistocene — California. Pliocene — Panama and Okinawa. Miocene — Dominican Republic and New Zealand.

CHARACTERISTIC SPECIES—

Recent — *agassizii* (Dall, 1908), *angelana* Hanna, 1924 (= *dalli* Arnold, 1903), *barbarensis* Dall, 1919, *bartschi* (Arnold, 1903), *callicesta* (Dall, 1902), *civittella*, Dall, 1920, *coronadoi* (Dall, 1908), *diegensis* (Dall, 1908), *hooveri* (Arnold, 1903), *nicoli*, *nychia* and *omphale* Dall, 1919, *pinosensis* Bartsch, 1944, *saccoi* (Dall, 1908). Pleistocene — *angelana* Hanna, 1924, *bartschi* (Arnold, 1903), Pliocene — *adamsi* and *harrisi* (Olsson, 1942), *shinzato* Mac Neil, 1960. Miocene — *recurvirostris* (Gabb, 1873), *sinelirata* Marwick, 1931.

Genus **DIPTYCHOPHLIA** Berry, 1964,

Leaflets in Malacology, Redlands, California, 1 (24), p. 150. Type (o.d.) *Clavatula occata* Hinds, 1844.

*Plate 8, fig. 15*

Shell small, 10 mm., very slender, with a tall spire of rather loosely wound lightly convex whorls, and a long narrow body-whorl, tapered gradually to a relatively long, straight, spout-like, unnotched anterior canal. Adult sculpture of rather distant, strong vertical axial folds, extending from suture to suture and over most of the base, overridden by narrow sharply raised spiral cords. Sinus subsutural, broad and shallow. Columella with two distinct folds and occasionally an incipient third one. Colour light yellowish-brown. Range — Recent, known only by the type species which is from Panama.

Genus **SCOBINELLA** Conrad, 1848,

Journ. Acad. Nat. Sci. Phil. ser. 2, 1, p. 120. Type (monotypy) *Scobinella coelata* Conrad, 1848. Syn. *Zelia* de Gregorio, 1890. Mon. faune éoc. Alabama, p. 44. Type (o.d.) *Borsonia* (*Zelia*) *sativa* Gregorio, 1890.

*Plate 8, fig. 16*

Shell moderate sized to large, 10-70 mm., solid, narrowly claviform, with a tall spire of lightly rounded whorls, and a narrow body-whorl slowly tapered to a moderately long and straight unnotched anterior canal. Protoconch, typically, a low stout cone of about 2½ whorls, of which less than the last half whorl bears heavy axial riblets. Sculpture of linear spaced prominent spiral cords, all of which are



crossed by deep linear grooves, which break them up into revolving series of closely spaced squarish nodes. Sinus deep, with a broadly rounded apex, situated on the lower part of the shoulder slope. Interior of the aperture strongly lirate. Columella bearing a series of low *Mitra*-like folds. Range—Eocene and Oligocene of the Southern United States and Miocene of the West Indian region, Mexico, Panama and Peru.

#### CHARACTERISTIC SPECIES—

Eocene — *famelica* Casey, 1903, *ferrosilica* and *louisianae* Harris, 1937, *newtonensis* Aldrich, 1911, *sativa* (Gregorio, 1890), *transitionalis* Harris, 1937. Oligocene — *coelata* Conrad, 1848, *famelica* and *macer* Casey, 1903, *meloda* Olsson, 1930, *pluriplicata* Casey, 1903, *prionota* Cooke, 1928, *taylorensis* Mansfield, 1940. Miocene — *magnifica* (Gabb, 1873), *morieri* (Laville) Cossmann, 1913, *tristis* Pilsbry & Johnson, 1917.

#### Genus MONILIOPSIS Conrad, 1865,

Amer. Journ. Conch. 1(2), p. 143. Type (monotypy) *Pleurotoma elaborata* Conrad, 1833.

##### Plate 8, figs. 19, 20

Shell of small to moderate size, 7-24 mm., tall-spined but with a truncated body-whorl, ending in a short broadly and shallowly notched anterior canal. Protoconch tall and narrowly conical, of 3-3½ smooth rounded whorls, with a minute erect tip, followed by a whorl of strong slightly concave axials. Adult sculpture of linear incised spiral series of rectangular nodes. Sinus area narrow and sunken, bearing a nodular spiral of about half the strength of the one submarginating the suture and those from the lower edge of the shoulder downward. Sinus rather shallow, U-shaped and contained within the narrow shoulder sulcus. Range — Eocene of the southeastern United States. Also recorded from the Eocene of Peru. The genus has been used to include Pliocene to Recent West American shells now covered by the clavinid genus *Ophiodermella*, which is superficially similar but has a different protoconch, narrowly conical, of about two loosely wound smooth whorls.

The genus appears to be closely allied to *Scobinella* but lacks the columellar plications of that genus; nevertheless relationship with the *Borsoniinae* seems to be indicated.

#### CHARACTERISTIC SPECIES—

*elaborata* (Conrad, 1833), *hammettensis* and *nassiformis* Harris, 1937, *sculpturata* (Aldrich, 1911).

#### Genus DOMENGINELLA Vokes, 1939,

Ann. New York Acad. Sci. 38, p. 121. Type (o.d.) *Turris claytonensis* Gabb, 1864.

##### Plate 8, figs. 17, 18

Shell small, 9-10 mm., biconical, with a moderately tall spire and a gradually tapered body-whorl, ending in a short unnotched anterior canal. Adult sculpture of heavy spiral cords, cut into prominent gemmules by deeply incised axial grooves. There is a heavy rounded subsutural fold, followed by a deep rather nar-

row shoulder sulcus, after which the beaded sculpture commences. The genus is stated by its author to resemble *Scobinella* in all respects except for the absence of columellar plications. Range — The type species is from the Dom-engine horizon, Eocene of California.

Vokes stated (l.c., p.122) that *claytonensis* appears to be the only known Californian species referable to *Domenginella*, but *Pleurotoma microcheila*, and possibly *dilinum*, *dis-similis* and *pupa*, all of Edwards (1861), from the English Eocene, appear to belong to the genus. However, these species have been referred, probably more reasonably, to *Asthenotoma* by Glibert (1960, Mem. Inst. Roy. Sci. Nat. Belg. 64, pp. 64-67).

#### Genus PLENTARIA Harris, 1937,

Palaeontographica Amer. 2, 7, p. 59. Type (o.d.) *Pleurotoma* (*Borsonia*) *plenta* Aldrich & Harris, 1895.

##### Plate 8, fig. 21

Shell moderately large, 26-48 mm., elongate-fusiform, with a tall flat-sided spire and a narrow body-whorl, slowly tapered to a long straight unnotched anterior canal. Protoconch narrowly conical of four whorls, smooth except for the last half whorl, which bears strong axial riblets. Adult sculpture of numerous narrow crisp spirals, with 1 - 3 fine threads in the interspaces, but mainly about the middle of the body-whorl to the neck. The sinus is broadly arcuate, not very deep and occupies most of the shoulder slope, from below a subsutural marginating fold. Inner lip with a single strong plait and sometimes one or two very weak ones immediately below it. Outer lip strongly lirate within.

The rather similar *Protosurcula* has a different protoconch of six whorls, three of them axially costate, a deeper and narrower sinus, and a much weaker pillar plait. Range — Claiborne Eocene of Louisiana and Texas.

#### CHARACTERISTIC SPECIES—

*horrida* (Harris, 1937) and *plenta* (Aldrich & Harris, 1895).

#### Genus PROTOSURCULA Casey, 1904,

Trans. Acad. Sci. St. Louis 14, p. 144. Type (o.d.) *Surcula gabbii* Conrad, 1865.

##### Plate 9, figs. 1, 2

Shell moderately large, in excess of 30 mm., elongate-fusiform, with a tall spire of rather straight outlines and a long straight unnotched anterior canal. Protoconch large, narrowly conical of about six whorls, first two smooth, the next with a few spiral threads, and the remainder with closely spaced curved protractive axials and spirally lirate interspaces. Adult whorls densely spirally lirate or cordate. There is a broadly rounded low subsutural fold, followed by a weak shoulder sulcus. Sinus deep, U-shaped, its apex on the lower part of the shoulder sulcus. The main characteristic of the



genus is the almost complete absence of axial sculpture.

The genus is of uncertain subfamily location, it may be turriculid and related to *Eosurcula*, or on the other hand, the tendency to develop a pillar plication, suggests possible alliance with the borsonid genus *Plentaria*, which it closely resembles in general facies. Range — Claiborne Eocene of Texas and northern Mexico.

CHARACTERISTIC SPECIES—

*gabbii* (Conrad, 1865), *platysoma* (Heilprin, 1880), *tenuirostris* Casey, 1904.

Genus VAUGHANITES Woodring, 1928,  
Carnegie Inst. Washington Publ. no. 385, p. 200.  
Type (o.d.) *Vaughanites leptus* Woodring, 1928.

Plate 9, fig. 3

Shell of moderate size, 17.9 mm., very slender, *Mitra*-like, with an attenuated spire and a rather short and narrow aperture, produced into a long straight unnotched anterior canal. Protoconch of 2 - 3 whorls, the last sculptured with coarse axial riblets. Adult sculpture of a few strong but narrow spiral cords, and almost equally strong interstitial thin axials, combining to produce an open latticed effect. Sinus rather wide and shallow, its apex lying on a prominent spiral some distance below the suture. Columella straight and bearing two closely and medially placed strong plaits. Outer lip apparently thin. Range — Known only by the type species from the Miocene of Jamaica.

Genus EOSCOBINELLA Powell, 1942,  
Bull. 2, Auck. Inst. Mus. p. 122. Type (o.d.) *Eosco-  
binella tahuia* Powell, 1942.

Plate 9, fig. 4

Shell of moderate size, 17-18 mm., *Exilia*-like, elongate-fusiform, with a very tall slender spire and a narrow body-whorl, gradually tapered to a long straight anterior canal. Protoconch imperfect, but indicated as narrowly conical of about five smooth whorls, followed by a half-whorl of strong brephic axials. Adult sculpture of moderately strong, slightly oblique broadly rounded axials, which extend from the shoulder angle to the lower suture, but are obsolete over the body-whorl. Surface from the shoulder angle downward crossed by weakly incised linear spiral grooves. Sinus moderately deep and rounded, occupying most of the shoulder slope. Aperture damaged in the only known specimen but indicated as long and narrow. Pillar straight, bearing seven weak oblique plications. The very slender shape, tall and narrow polygyrate protoconch and multiple very oblique pillar plications separate the genus from other members of the subfamily. Range — Known only by the type specimen, which is from the Kaiatan upper Eocene of McCullough's Bridge, South Canterbury, New Zealand.

Genus MITRATOMA Olsson, 1930,  
Bull. Amer. Paleont., Ithaca, 17, p. 37. Type (o.d.)  
*Scobinella (Mitratoma) bartschi* Olsson, 1930.

Plate 9, figs. 5, 6

Shell medium sized, 16.25 mm., *Mitra*-like, but with a deep subsutural sinus and sunken fasciole, which occupies most of the shoulder slope, below a strong subsutural fold. Sculpture of strong oblique but rather short peripheral axials, that do not cross the shoulder slope and barely reach the lower suture. In addition to the strong subsutural fold there are about seven broad flat linear-spaced spirals on the base. Aperture narrow and long, terminated in a short undifferentiated broadly notched anterior canal. Columella straight, bearing four low *Mitra*-like plicae. Interior of the thin edged outer lip strongly lirate. Range — Known only by the type species which is from the Eocene Talara Formation of Northern Peru.

Genus EUCHEILODON Gabb, 1860,  
Journ. Acad. Nat. Sci. Phil. 2nd ser. 4, p. 379. Type  
(monotypy) *Eucheilodon reticulata* Gabb, 1860.

Plate 9, fig. 7

Shell small to moderate sized, 10-22.5 mm., ovate-biconic. Protoconch large of five whorls, first four elevated conical and smooth, the last closely axially costate. Adult whorls rounded, obscurely subangled at about two-thirds whorl height; conspicuously sculptured with numerous flat-topped spiral cords, latticed by numerous thin interstitial axial threads. Aperture narrow, produced below into a long straight unnotched anterior canal. Outer lip thin at its edge but thickened behind and strongly dentate within. Inner lip beaded for almost its entire length, but this latter feature is developed only in mature shells. Sinus apparently a broadly open V, on the weakly defined shoulder angulation.

The illustration of the type species has the anterior canal missing but its normal condition is shown in the figure of *crenocarinata* Heilprin.

Range — Jackson and Claiborne Eocene of Texas, Mississippi and northern Mexico.

CHARACTERISTIC SPECIES—

*crenocarinata* Heilprin, 1880, *gabbianum* Casey, 1904, *reticulata* Gabb, 1860, *reticulatoides* (Harris, 1895).

Genus BURIDRILLIA Olsson, 1942,  
Bull. Amer. Paleont. 27, no. 106, p. 52. Type (o.d.)  
*Clathrodrillia (Buridrillia) panarica* Olsson, 1942.

Plate 9, figs. 8, 9

Shell large, 72 mm., narrowly claviform, with a tall slender turreted spire and a long narrow body-whorl, produced into a relatively long straight unnotched anterior canal. Protoconch unknown. Adult sculpture of heavy protractively oblique broadly rounded axials, which commence strongly and suddenly at the lower edge of a relatively broad and steep



shoulder sulcus. Surface from below the shoulder sulcus overridden by weak spiral cords and lirae. Sinus deep, U-shaped, occupying most of the shoulder sulcus. Pillar straight, generally with a large, broad, thickened fold. Range — The Pliocene of Charco Azul, Panama (type) and Quebrada Penitas, Costa Rica.

Olsson made his *Buridrillia* a subgenus of *Clathrodrillia*, which is definitely clavinid. He also compared it with both *Borsonia ephigona* Martens, 1904 (Gast. Tiefsee Exped. p. 91, pl. 2, f. 2), a deep water shell from off Sumatra, and Bartsch's *Darbya* from the Puerto Rican deep. The latter is also claviform and has a broad columellar fold, similar to that of *Buridrillia*, but situated well within the aperture and not visible from the front view. The two genera are evidently closely allied, and may prove to be identical.

#### Genus DARBYA Bartsch, 1934,

Smithsonian Misc. Coll. 91(2), p. 22. Type (o.d.) *Darbya lira* Bartsch, 1934.

##### Plate 9, figs. 10-12

Shell of moderate size, 22.6 mm., very slender, with a very tall narrowly tapered spire and a narrow body-whorl, truncated to a relatively short unnotched anterior canal. Protoconch globular of  $1\frac{1}{2}$  smooth whorls. Adult sculpture of a narrow but distinct smooth subsutural cord, followed by a narrow rather shallow shoulder sulcus, below which there are numerous vertical fold-like axials, overridden by numerous smooth spiral cords. Aperture rather narrow, with a thin outer lip, but there is a varix half a whorl back from the lip. Sinus moderately deep, U-shaped, occupying the shoulder sulcus, and accentuated in depth by an arcuate forward swing of the outer lip. Columellar lip with a rather broad callus which bears within, a strong broad blunt projection or fold, which is separated from the parietal whorl by a deeply concave channel. Colour pale yellowish with a faint brown band on the shoulder sulcus and extending a short way below it. The genus is referred to the Borsoniinae on account of the inner lip process but whether this is comparable with the pillar plaits of that subfamily is conjectural; otherwise the genus has a clavinid facies reminiscent of *Inquisitor* and similar elongate-fusiform genera. Range — Known only by the type species which is from the Puerto Rican Deep in 80-360 fathoms.

#### Genus BATHYTOMA Harris & Burrows, 1891,

Eoc. Olig. Beds Paris Basin, p. 113, nom. nov. for *Dolichotoma* Bellardi, 1875, Bull. Soc. malac. Ital., p. 21. Type (monotypy) *Murex cataphractus* Brocchi, 1814 (non *Dolichotoma* Hope, 1839).

##### Plate 9, fig. 13

Shell large, 40-85 mm., solid, biconical, moderately wide and capacious, with a conical

spire, usually of rather straight outlines, and an elongated body-whorl, slowly contracted to an undifferentiated, short, broadly and shallowly notched anterior canal. Protoconch conical of  $2\frac{1}{2}$ - $3\frac{1}{2}$  whorls, the tip small and pointed, smooth, except for concavely arcuate axial riblets, which develop over the last whorl. Adult sculpture of closely spaced spiral cords, rendered gemmucose by dense axial growth threads. Typically and frequently there is a peripheral carinate flange or sinus rib, that develops tubercles at the apex of successive sinus growth curves. Outer lip thin edged, with a peripheral sinus that is a broadly open V at its entrance but contracts to a narrow U at its apex. The type species is strongly lirate within the outer lip and usually bears a distinct oblique plait on the submedian part of the columella. Recent species do not appear to have apertural lirations but most have a columellar plait or fold, often quite pronounced. The colour is usually dull white but the Caribbean *viabrunnea* Dall is light brownish with a peripheral reddish-brown band. Range — Widely distributed both Tertiary and Recent; Eocene to Pliocene of Europe, Eocene of the Southern United States, Miocene of India and the East Indies, Oligocene and Miocene of New Zealand and Recent in the deep-water basins of the Caribbean and Indo-Pacific.

Despite the peripheral position of the apex of the anal sinus, the presence of a well marked pillar plait or fold suggests closer alliance with the *Borsoniinae* than with the *Turrinae*. The undoubtedly closely allied *Micantapex* has a radula consisting of a pair of long slender, non barbed awl-shaped marginals (*finlayi* Powell, 1940 and *parengonius* Dell, 1956), very similar to those of *Borsonella* (*callicesta* Dall 1902, *coronadoi* Dall, 1908 and *barbarensis* Dall, 1919), not the wishbone type or its modifications, which are characteristic of the *Turrinae* and *Turriculinae*.

#### CHARACTERISTIC SPECIES—

Recent, INDO-PACIFIC, *atractoides* (Watson, 1881) and subsp. *aethiopica* and *obsolescens* (Martens & Thiele, 1903), *bitorquata* (Martens, 1901), *fissa* (Martens, 1901), *oldhami* (Smith, 1899), *regnans* Melvill, 1918. CARIBBEAN, *viabrunnea* (Dall, 1889). Pliocene — EUROPE, *cataphracta* (Brocchi, 1814). Miocene — EUROPE, *degrangei* Peyrot, 1932, *doliolum* (Bellardi, 1878), *mioturbida* Kautsky, 1925, *tournoueri* Peyrot, 1932. INDIA, *gedrostana* (Vredenburg, 1925), NEW ZEALAND, *finlayi* Laws, 1939, *wairarapaensis* Vella, 1954. Oligocene — EUROPE, *collaris* (Noszky, 1940), *hantoniensis* (Edwards, 1861). S.E. UNITED STATES, *marieana* (Aldrich, 1911). NEW ZEALAND, *bartrumi* Laws, 1939, *haastii* (Hutton, 1887), *hokianga* Laws, 1947, *mitchelsoni* Powell, 1935. Eocene — EUROPE, *granata* (Edwards, 1861), *ligata* (Edwards, 1861), *turbida* (Solander, 1766). S.E. UNITED STATES, *nonplicata* Harris, 1937.

#### Subgenus PARABATHYTOMA Shuto, 1961 (of *Bathytoma*),

Mem. Fac. Sci. Kyushu Univ., ser. D, Geol. 11(2), p. 87. Type (o.d.) *Pleurotoma striatotuberculata* Yokoyama, 1928.



## Plate 9, figs. 14-16

This name was provided as a subgenus of *Bathytoma* for a Japanese lower Pliocene species, as follows — "The shell is moderate in size and biconical with the high spire and moderately long and tapering base. The protoconch is paucispiral with two or less smooth volutions, rather globular, and elevated but not pointed. The post-nuclear whorls are carinated close to the lower suture, gemmulated at the carina and spirally lirate on the shoulder and on the lateral surface. The aperture is long occupying about half of the shell length and narrowly pyriform with moderately deep and V-shaped anal sinus at the periphery, and is gradually narrowed below to the widely open canal."

Actually the protoconch as described above is not very different from that of *Micantapex* which is more depressed; it is also similar to that of the Recent Japanese *luhdorfi* (Lischke), which Shuto (l.c.) referred to *Bathytoma* typical, stating that the protoconch is polygyrate. This is not the case, however, as shown by a series of Recent Japanese shells, in all of which the protoconch is globose of about two smooth whorls.

If I am correct in associating the Recent *luhdorfi* with the lower Pliocene type of *Parabathytoma* then the group is further distinguishable from typical *Bathytoma* in its sinus, which is V-shaped in immature shells but finally becomes a deep parallel-sided U in the adult stage. Also the radula of *luhdorfi* (Oyama, 1954, Venus, 18(1), p. 17, fig. 1) differs from that in the several species of *Micantapex* examined, in having a hooked termination to the long slender marginals.

The Recent *luhdorfi* is rather large, up to 70 mm., solid, boldly sculptured with broad flat-topped spirals with incised linear interspaces. A prominent rounded carina at above middle whorl height is studded with bluntly rounded nodes. Colour pale yellowish-brown, usually with the spirals in pale reddish-brown. Operculum leaf-shaped with a terminal nucleus. Radula (text fig. E120) as described above. Range — Recent, seas of Japan and middle Miocene to lower Pliocene of Japan.

## CHARACTERISTIC SPECIES—

Recent — *luhdorfi* (Lischke, 1872). Lower Pliocene to middle Miocene — *luhdorfi* (Lischke, 1872), *striatotuberculata* (Yokoyama, 1928).

Subgenus RIUGUHDRILLIA Oyama, 1951 (of *Bathytoma*),

Bull. Biogeogr. Soc. Japan, 15(2), pp. 3, 4. Type (monotypy) *Drillia engonia* Watson, 1881.

## Plate 9, figs. 17, 18

The author stated that his 'genus' is broader than *Suavodrellia*, having granules on its keel, and is a deep sea dweller. However *Riuguhdrillia* is not very different from *Micantapex*, for both have a similar sinus on the peripheral

keel, whereas in *Suavodrellia* it is on the shoulder slope immediately above the peripheral keel.

It seems that *Riuguhdrillia* warrants subgeneric distinction, not only on account of its very thin shell, with non granulose surface sculpture, except for subsutural plicae and weak peripheral nodes, but also by the presence of a persistent periostracum, and a rather distinctive radula, which consists of a pair of narrow curved lanceolate simple pointed marginals, with an expanded three angled base (*parengonia* Dell; text fig. E121). In *finlayi* Powell, which is a typical *Micantapex*, the marginals are slender also, but straight and the triangulate base has the central portion produced so that the whole tooth resembles a hilted dagger. Range — Known only by the type species, *engonia* (Watson, 1881), from 345 fathoms off Japan, and the New Zealand *parengonia* (Dell, 1956), from 260-290 fathoms on the Chatham Rise.

Subgenus MICANTAPEX Iredale, 1936 (of *Bathytoma*),

Rec. Austr. Mus. 19, p. 319. Type (o.d.) *Bathytoma agnata* Hedley & Petterd, 1906.

## Plate 9, figs. 19, 20

Shell of moderate size, 20-40 mm., very similar to *Bathytoma* typical, but smaller and of lighter build. The chief difference is in the protoconch which is paucispiral, blunt, subglobose, of about 1½ smooth whorls. Colour dull white. Radula (*finlayi* Powell; text fig. E119) consisting of a pair of long slender straight marginals, with a triangulate base, but the central part is produced so that the whole tooth resembles a hilted dagger, while in *B. (Parabathytoma) luhdorfi* (Lischke; text fig. E120) the curved slender marginals are hooked at the point. Range — Recent, Eastern Australia and New Zealand, 26-300 fathoms, Pleistocene, Japan and New Zealand, Pliocene, Japan, Victoria and New Zealand, Miocene, Okinawa, Victoria and New Zealand, Oligocene, Japan, Tasmania and Victoria.

## CHARACTERISTIC SPECIES—

Recent — *agnata* (Hedley & Petterd, 1906), *finlayi* Powell, 1940, *lacertosus* (Hedley, 1922), *profundis* Laceron, 1954. Pleistocene — JAPAN, *oyamia* Makino & Ogoe, 1959, NEW ZEALAND, *murdochi* (Finlay, 1930) (= *tuberculata* Kirk, 1882 = *nodilirata* Murdoch & Suter, 1906) and subsp. *prior* Vella, 1954, *paucispiralis* Powell, 1942. Pliocene — JAPAN, *matsumotoi* Shuto, 1961, VICTORIA, *pritchardi* (Tate, 1894), NEW ZEALAND, *discors* Powell, 1942, *fortinodosa* (Marwick, 1931), *hawera* (Laws, 1940), *proavitus* Powell, 1942. Miocene — OKINAWA, *tomuiensis* Mac Neil, 1960, VICTORIA, *decomposita* (Tate, 1894), *perarmatus* and *parri* Powell, 1944, *rhomboidalis* (Tenison-Woods, 1880) (= *angustifrons* Tate, 1894), NEW ZEALAND, *filaris* (Marwick, 1931), *media* and *ngatapa* (Marwick, 1931) *pergracilis*, and *praecisa* (Marwick, 1931), *pulcherrimus* Vella, 1954, *tenuineta* (Marwick, 1931). Oligocene — JAPAN, *rugosa* (Takeda, 1953, TASMANIA, *conspicua* (May, 1921), VICTORIA, *fontinalis* (Tate, 1894).



NOTE — The species *angustatus* Powell, 1940, described as a *Micantapex*, has wish-bone-type marginals, and is transferred to *Lucerapex*.

Genus *PARABORSONIA* Pilsbry, 1922,  
Proc. Acad. Nat. Sci. Phil. for 1921, pt. 2, p. 325.  
Type (o.d.) *Mitra varicosa* Sowerby, 1850.

Plate 9, fig. 21

Shell moderately large, 14-24 mm., biconical, *Bathytoma*-like, but with two very strong and well formed pillar plaits. Protoconch blunt tipped of 1½ smooth low rounded whorls. Adult sculpture of numerous spiral cords and threads crossed by interrupted and rather meandering axial threads, granose at points of intersection. The whorls are conspicuously keeled below middle whorl height by a bicarinate tubercular sinus fasciole, the tubercles vertically fused, producing a cog-like peripheral flange. Sinus a broadly open V, its apex on the peripheral flange. Aperture rather narrow, gradually tapered to a short undifferentiated unnotched anterior canal. Range — The Miocene of the Dominican Republic (type locality), Costa Rica, Trinidad and Java.

CHARACTERISTIC SPECIES—  
*brassoensis* Mansfield, 1925, *cocoensis* (Olsson, 1922), *varicosa* (Sowerby, 1850), *cossmanni* and *volzi* (Martin, 1914).

Genus *GLYPTOTOMA* Casey, 1904,  
Trans. Acad. Sci. St. Louis, 14, p. 140. Type (s.d. Gardner, 1945) *Pleurotoma crassiplicata* Gabb, 1860.

Plate 10, fig. 1

Shell small, 3.9-12 mm., solid, biconical, with a moderately tall spire of relatively straight outlines, and a rounded body-whorl, slowly tapered to a short, slightly flexed spout-like anterior canal. Protoconch small, blunt, of 3-4 smooth whorls, the tip immersed. Adult sculpture of strong nodulose spirals, the heaviest one submarginating the suture, and two with vertically fused nodes forming the peripheral carina. Sinus V-shaped, its apex on the peripheral carina. Interior of the thin edged outer lip strongly lirate. Columella with a distinct ridge or fold which is bi- or trifurcate. Harris (1937, *Palaeontographica Amer.* 2, 7, p. 23) made *Glyptotoma* a section of *Bathytoma*, but Gardner (1945, *Geol. Soc. Amer.* mem. 11, p. 248) considered the relationship to be with *Scobinella*. However, on account of the peripheral position of the sinus, Harris' opinion is preferred, except that the group deserves generic status, as was given it by Gardner. It is a miniature *Bathytoma*-like shell with a tendency toward multiple splitting of the columellar fold, and has a distinctive protoconch. Range — Oligocene of Mexico and Eocene of Texas and Louisiana.

CHARACTERISTIC SPECIES—  
Oligocene — *rhombica* Cooke, 1928. Eocene — *conradiana* (Aldrich, 1895), *crassiplicata* (Gabb,

1860) and subsp. *montgomeryensis* (Harris, 1937), *fisherana* (Harris, 1937), *parvula* Casey, 1904.

Genus *APHANITOMA* Bellardi, 1875,  
Bull. Soc. malac. Ital. 1, p. 22. Type (s.d. Powell, 1942) *Turbinella labellum* Bellardi & Michelotti, 1841.

Plate 9, fig. 22

Shell of small to medium size, 8-23 mm., narrowly ovate-fusiform, with a tall spire of lightly convex whorls, and a long narrow body-whorl, gradually tapered to a short almost undifferentiated anterior canal. Protoconch small, of two smooth whorls. Adult sculpture of long axial folds, extending from suture to suture, but usually becoming subobsolete over the latter part of the body-whorl; the whole overridden by prominent spiral cords. Aperture narrowly ovate. Outer lip thin edged, with an almost sutural sinus, which is broad and shallowly concave but merges below with a forward arcuate swing of the lip. Inner lip narrowly smooth callused, bearing two median placed plications. The genus appears to be closely allied to the New Zealand Oligocene *Vexithara*. It would appear, however, that the main difference is in the sinus, which is much shallower in *Vexithara*, and the outer lip does not swing forward below, as it does strongly in the type species of *Aphanitoma*. Range — The type and most of the species are from the Miocene of Italy; also from the Pliocene of Italy and the Miocene of Belgium. Denmark and France.

CHARACTERISTIC SPECIES—  
Pliocene — *acutiplicata* Sacco, 1904, *arctata* Bellardi, 1877, *targioniana* (Ancona, 1872). Miocene — *bellardii* Seguenza, 1879, *breviata* Bellardi, 1877, *delicatum* Glibert, 1954, *glejbjergensis* Sorgenfrei, 1958, *labellum* (Bellardi & Michelotti, 1841), *miocaenica*, *pecchiolii*, *pluriplicata* and *tumescens* Bellardi, 1877.

Genus *ASTHENOTOMA* Harris & Burrows, 1891,

Eoc. and Olig. beds Paris Basin, p. 113; nom. nov. pro *Oligotoma* Bellardi, 1875 (non Westwood, 1836), Bull. Soc. Malac. Ital. 1, p. 21. Type (o.d.) *Pleurotoma meneghinii* Mayer, 1868=*tuberculata* Pusch, 1836.

Plate 9, fig. 23

Shell small to moderate sized, 6-28 mm., narrowly claviform, with a tall spire of rather straight-sided whorls, and a narrow ovate body-whorl, contracted to a short neck, followed by a short recurved shallowly notched anterior canal. Protoconch small, narrowly conical of 3-3½ smooth whorls. Adult sculpture of spiral cords, often crenulated or gemmulated by numerous irregular axial flexuous folds. There is a weak to moderate subsutural fold but the shoulder sulcus is usually poorly developed. Aperture narrowly pyriform. Outer lip thin with a moderate U-shaped sinus, having broadly divergent angles of approach, the apex on the lower half of the shoulder slope. The inner lip is heavily callused, smooth but with the



median area of the pillar obliquely thickened but not actually plicate.

The systematic position is difficult to decide; it may be clavinid, allied to *Microdrillia* and *Tomopleura*, or on the other hand, it may be borsonid, in which the pillar is callused into a thickened fold, comparable with the plicae of that subfamily. Range — Eocene to Miocene of Europe, Eocene of the S.E. United States, Miocene and Pliocene of Java and Ceram. The Recent records of the genus seem to refer to species of *Tomopleura*.

CHARACTERISTIC SPECIES—

Pliocene (Java) — *bantamensis* Oostingh, 1938, *idjowensis* Oostingh, 1938, *subterebalis* Oostingh, 1938, *terhaari* Oostingh, 1935, (Ceram) — *epitonica* (Fischer, 1927), (India) — *terebralis* Cossmann, 1903. Miocene (Europe) — *basteroti* (Desmoulins, 1842), *colus* (Dujardin, 1837), *ex-basteroti* Pevrot, 1932, *falunica* Peyrot, 1938, *festiva* Hoernes, 1856, *intersecta* (Bellardi, 1877), *meneghini* (Mayer, 1868), *mirabilis* (Bellardi, 1877), *obesa* Peyrot, 1932, *ornata* (Defrance, 1826), *pannoides* Koenen, 1882, *tricarinata* Peyrot, 1932, (Java) — *elberti* Martin, 1914, *nanggulanensis* Martin, 1931, *tobleri* Martin, 1914. Oligocene (Europe) — *bicinctulata* Sandberger, 1862, *obliquinodosa* (Sandberger, 1863). Eocene (Europe) — *bracheia* (Edwards, 1861), *burrowsi* (Boury, 1899), *cossmanni* (Raincourt, 1884), *crassilirata* (Boury, 1899), *dissimilis* (Edwards, 1861), *fayellensis* (Boury, 1899), *helicoides* (Edwards, 1861), *lirisculpta* (Boury, 1899), *microcheila* (Edwards, 1861), *mitraeformis* (Boury, 1899), *pannus* (Basterot, 1825), *pupa* (Edwards, 1861), *rugosa* (Boury, 1899), *zonulata* (Edwards, 1861), (S.E. United States) — *danvitexa* Palmer, 1947, *eximia* Casey, 1904, *strigosa* Casey, 1904.

Genus ENDIATOMA Cossmann, 1896,

Essais Pal. Comp. 2, p. 106. Type (o.d.) *Aphanitoma quadricincta* Cossmann, 1883.

Plate 9, fig. 24

Shell small, 13 mm., very slender, with a tall narrowly tapered spire of flat outlines, and a narrow body-whorl constricted to a distinct neck and ending in a short unnotched spout-like anterior canal. Protoconch small, smooth and conoidal of  $2\frac{1}{2}$  whorls. Adult sculpture of heavy flat-topped spiral cords, 3-4 on the spire whorls additional to a narrow subsutural spiral fold. Outer lip thin and apparently without a sinus. Inner lip with a moderately wide callus, having a defined edge, and below middle height, there is a strong oblique pillar plait. The genus resembles *Aphanitoma*, except for the obsolete sinus and single pillar plait. Range — Known only by the type species which is from the Eocene of Saint Gobain, Paris Basin, France.

Genus NICOLIA Gregorio, 1880,

Fauna S. Giov. Ilarione 1, p. 61. Type (monotypy) *Borsonia (Nicolia) solitaria* Gregorio, 1880 (according to Wenz, 1943, Handb. der Pal. p. 1424), Eocene of Europe.

Dall (1918, Proc. U.S. Nat. Mus. 54, p. 329) assumed that Gregorio's name was preoccupied by "*Nicolia*" Malmgren, 1865, in Vermees, but the original spelling of Malm-

gren's genus was *Nicolea*. I have not been able to refer to Gregorio's paper so can offer no further comments at this stage.

Genus CRYPTOBORSONIA Powell, 1944,

Rec. Auck. Inst. Mus. 3(1), p. 43. Type (o.d.) *Cryptoborsonia pleurotomella* Powell, 1944.

Plate 10, fig. 2

Shell small, 8.5 - 10 mm., biconic; whorls weakly shouldered above the middle; body-whorl gradually tapered to a short unnotched anterior canal. Protoconch relatively large, papillate of two smooth rounded whorls. Adult sculpture of numerous narrow spiral cords crossed by broadly rounded axials, confined to the early whorls in the type species, but fading out over the latter half of the body-whorl in the second species, *rugobela*. Sinus rather deep, arcuate, occupying the whole of the shoulder slope and confluent below with an arcuate forward sweep of the thin outer lip. Pillar with a median slight twist-like ridge.

The subfamily location of the genus is a little uncertain; the sinus is similar to that of the daphnellid genus *Rugobela*, in which the subsutural character of the sinus is masked by a forward trend at the suture. However, by virtue of the twist-like ridge on the pillar, scarcely a plait, the genus seems to have most in common with the *Borsoniinae*.

Range — Known only from the Oligocene and Miocene of Victoria, Australia.

CHARACTERISTIC SPECIES—

Miocene — *pleurotomella* Powell, 1944. Oligocene — *rugobela* Powell, 1944.

Genus SCRINIUM Hedley, 1922,

Rec. Austr. Mus. 13(6), p. 258. Type (o.d.) *Mitromorpha brazieri* Smith, 1891.

Plate 10, fig. 7

Shell small to moderate sized, 5 - 16 mm., ovate-biconic, with a low dome-shaped, smooth, paucispiral protoconch. Adult whorls more or less evenly rounded, without, or with a very faintly indicated, fasciolar shoulder sulcus. Sub-sutural fold absent or poorly developed. Sculpture of obscure low rounded axials and faint spiral grooves. Aperture ovate, terminated in a very short, wide, unnotched anterior canal. Outer lip thin, smooth, with a very shallow, scarcely distinguishable subsutural sinus. Columella slightly twisted below. Operculum irregularly ovate, with a terminal nucleus (*neozelanica*).

Radula, a pair of marginals only, which are rather long, slightly curved, gradually tapered to a single-barbed point, and with an expanded knuckle-shaped base (*neozelanica*; text fig. E118). If *neozelanica* is congeneric with the Australian Recent type species of *Scrinium*, which seems to be a reasonable assumption, then the genus is probably a borsonid, without pillar plaits, for the radula is of identical type

to that figured by Thiele (1929, Handb. Syst. Weicht., 1, p. 365, fig. 449) for *Borsonia ochracea*, Thiele, 1925.

Animal with small narrowly cylindrical cephalic tentacles, the eye on a ledge, about one fourth way down the distal side from the tip. From the eye ledge upward the tentacle is much reduced in thickness, and this extremity doubtless acts as a protective feeler to the eye (*neozelanica*). This style of tentacle is similar to those of *Aotadrillia*, *Maoritomella*, *Phenatoma* and *Splendrillia* (original information kindly made available by Mr Winston Ponder). Range — (typically) Recent, Australia and New Zealand, (atypically) Oligocene and Miocene of Australia, and Oligocene and lower Pliocene of New Zealand.

#### CHARACTERISTIC SPECIES—

Recent (Australia) — *brazieri* (Smith, 1891), *fur-tivum* Hedley, 1922, *gatliffi* (Verco, 1909), (New Zealand) — *neozelanica* (Suter, 1908). Pliocene (New Zealand) — *strongi* Marwick, 1931, *thomsoni* Powell, 1942. Miocene (Australia) — *hemiothone* (Tenison-Woods, 1880). Oligocene (New Zealand) — *blandiatum* and *callimorphum* (Suter, 1917), *fin-layi* Powell, 1942, *ordinatum* (Hutton, 1877), *stiro-phora* (Suter, 1917). (Australia) — *duplicatum*, *haroldi* and *nanum* Powell, 1944.

Only the Recent species listed above can be considered really typical. Most of the Australian and New Zealand Tertiary ones are placed here tentatively, since they exhibit much stronger axial sculpture than in the Recent series. The New Zealand Recent *Scrinium sandersonae* Bucknill, 1927, is transferred to the mangelinid genus *Macteola*.

#### Group of mitromorphid genera

##### Genus MITROMORPHA Carpenter, 1865,

Ann. Mag. Nat. Hist. ser. 3, 15, p. 182. Type (monotypy) *Mitromorpha filosa* Carpenter, 1865. (non *Mitromorpha* A. Adams, 1865, Ibid. p. 322=*Antimitra* Iredale, 1917).

#### Plate 10, fig. 3

Shell small, 4-8 mm., solid, ovate-biconic; whorls convex but overlapping so that the spire profile is conical. Protoconch small of about 2 whorls, smooth, depressed-papillate the tip flattened and inrolled. Adult sculpture of strong spiral flat-topped cords, with numerous growth lines in the interspaces but no true axial sculpture. Aperture long and narrow, terminated in a short unnotched anterior canal; outer lip thin at the edge but internally thickened and denticulate; sinus obsolete. Inner-lip typically without plaits, folds or denticles. Colour of type species light reddish-brown. Radula toxoglossate, a pair of simple slender marginals, without barbs, slightly constricted in the middle and with a spreading spatulate base (*filosa* Carpenter; see Orr, 1959, Nautilus 72 (3), p. 77, fig. 2) (text figs E123, 124). Range — Pliocene to Recent, California, Pliocene of Florida and Miocene of Florida and France.

#### CHARACTERISTIC SPECIES—

Recent — *aspera* (Carpenter, 1864), *crassaspera* (Grant & Gale, 1931) (= *fusciligata* Dall, 1871), *carpenteri* Glibert, 1954 (= *filosa* Carpenter, 1865), *interfossa* (Carpenter, 1864). Pleistocene — CALIFORNIA; *barbarensis* Arnold, 1907, *galeana* Berry, 1941. Pliocene — FLORIDA; *cincta* Dall, 1890, *gunteri* Mansfield, 1931. Miocene — FRANCE; *filosa* (Dujardin, 1837).

##### Genus MITROLUMMA Bucquoy, Dautzenberg & Dollfus, 1883,

Moll. Mar. Roussillon 1, pp. 115, 121. Type (o.d.) *Mitra olivoidea* Cantraine, 1835. Syns. *Clinomitra* Bellardi, 1889, Mem. della Reale Accad. Sci. Torino, ser. 2, 39, p. 152 Type (monotypy) *Clinomitra rovasendae* Bellardi, 1889. *Diptychomitra* Bellardi, 1889, ser. 2, 39, p. 152 Type (Cossmann, 1899). *Diptychomitra exima* Bellardi, 1889.

#### Plate 10, fig. 4

Shell small, typically, 7-8 mm., but up to 29 mm. (*Clinomitra*), ovate-biconic, with spire and aperture height subequal. Protoconch narrowly dome-shaped, with an inrolled tip, of two smooth to minutely malleated whorls, ending in a protractively arcuate slight rim. Adult sculpture of strong flat-topped linear spaced spiral cords crossed by numerous axial folds, which become subobsolete over the body-whorl. Aperture long and narrow, terminating in a short undifferentiated unnotched anterior canal. Outer lip thin edged but internally thickened and denticulated. Sinus a distinct narrow subsutural channel. Inner lip callus bearing two distinct median plaits, the upper one slightly the stronger. Colour light brownish. Range — Recent, Mediterranean and West Africa, Pleistocene of Sicily, Miocene of France and Italy.

The genus appears to be very close to *Mitromorpha*, differing only in the presence of two well formed median pillar plaits.

Many authors have considered *Mitrolumma* to be mitrid, but now that *Mitromorpha*, by its radula, has been shown to be definitely turrid, it is almost certain that *Mitrolumma* goes along with it.

#### CHARACTERISTIC SPECIES—

Recent and Pleistocene — *olivoidea* (Cantraine, 1835). Miocene — *canaliculata* and *clathrata* (Bellardi, 1889), *cancellata* and *dollfusi* (Peyrot, 1938), *eximia* and *filifera* (Bellardi, 1889), *richaudi* (Micheliotti, 1847), *rovasendae* (Bellardi, 1889).

Cossmann (1899, Essais Pal. Comp. 3, p. 174) synonymized both *Clinomitra* and *Diptychomitra* with *Mitrolumma*, which he placed in the Mitridae. Wenz (1943, Handb. der Pal. 6, p. 1430) also synonymized these names with *Mitrolumma* but he referred that genus to the Turridae, near *Mitromorpha*.

##### Genus MITRITHARA Hedley, 1922,

Rec. Aust. Mus. 13(6), p. 233. Type (o.d.) *Columbella alba* Petterd, 1879.

#### Plate 10, fig. 5

Shell small, 4-13 mm., biconic to cylindro-fusiform. Protoconch dome-shaped of 2½



smooth whorls. Adult sculpture of spiral threads or cords, sometimes with weak fold-like axials as well, and occasionally with the axials dominant, and the spirals as interstitial threads. Aperture narrow, terminated in a short unnotched anterior canal. Outer lip thin, often lirate within, with a very weak, almost imperceptible, subsutural sinus. Columella bearing one or two medial plications. Colour white or buff, sometimes sparsely spotted with light brown. Range (typically) — Recent, Australia, New South Wales to Tasmania, South Australia and New Zealand. Pliocene, New Zealand. Miocene, Victoria. Oligocene, New Zealand.

The genus is very similar to *Mitromorpha*, differing mainly in the protoconch, which is narrowly dome-shaped of  $2\frac{1}{2}$  whorls, with a small erect pointed tip, and quite distinct pillar plaits. In *Mitromorpha* the protoconch is of about 2 whorls, depressed papillate, the tip flattened and inrolled, and the pillar plaits are obsolete or nearly so. Glibert (1954, Mem. No. 129, Inst. Roy. Sci. Nat. Belg., pp. 43-46) used *Mitriothara* for several species from the Miocene of the Loire Basin, France, but it is uncertain if their affinity is with that genus or with *Mitromorpha*.

#### CHARACTERISTIC SPECIES—

Recent — AUSTRALIA; *alba* (Petterd, 1879), *angusta* and *axicostata* (Verco, 1909), *bassiana* Gabriel, 1956, *columnaria* Hedley, 1922, *costifera* (May, 1919), *paucilirata* (Verco, 1909), *incerta* (Pritchard & Gatliff, 1902), *macphersonae* Gabriel, 1956, *multicostata* (May, 1911), *paula* (Verco, 1909), *proles* Hedley, 1922, *crassilirata* (Verco, 1909); NEW ZEALAND; *barrierensis* Powell, 1942, *gemmata* (Suter, 1908), *granulifera* Powell, 1937. Pliocene — NEW ZEALAND; *formosa* Marwick, 1931, *granosa* Marwick, 1928. Miocene — AUSTRALIA; *daphnelloides* (Tenison-Woods, 1880), *fenestrata* Powell, 1944, *megale* Chapple, 1941. Oligocene — NEW ZEALAND; *brachyspira* (Suter, 1917), *sutherlandica* and *waitakiensis* Powell, 1942.

Subgenus ITIA Marwick, 1931 (of *Mitriothara*), N.Z. Geol. Surv. Pal. Bull. 13, p. 143. Type (o.d.) *itia clatrata* Marwick, 1931.

#### Plate 10, fig. 6

Shell small, 5.6 - 6.5 mm., ovate-biconic, very similar to *Mitriothara* but with a larger, more broadly dome-shaped smooth protoconch, followed by a half whorl of brephic axials. That of *Mitriothara* is smaller, smooth also, but more narrowly conical, and passes into the adult sculpture without a brephic stage. Otherwise the two groups are very similar, both in their adult sculpture and in the possession of two rudimentary pillar plaits. Range — New Zealand, Recent, 150-300 fathoms, and Middle Miocene.

#### CHARACTERISTIC SPECIES—

Recent; *benthicola* Dell, 1962, *regis* (Powell, 1937). Miocene — *clatrata* Marwick, 1931.

Genus VEXITHARA Finlay, 1926,

Trans. N.Z. Inst. 56, p. 254. Type (o.d.) *Antimitra vexilliformis* Marshall & Murdoch, 1923.

#### Plate 10, fig. 8

Shell small, 8-11 mm., cylindro-biconic, with a turreted to coronated spire, otherwise resembling *Mitriothara*, except for the protoconch, which is peg-like, of two narrow erect smooth whorls. Adult sculpture of closely spaced spiral cords, one stronger than the rest, at the sharp shoulder angle; crossed by moderately strong vertical axial ribs, which weakly coronate the peripheral keel. Aperture narrowly lunate, terminated in an undifferentiated short unnotched anterior canal. Sinus very shallow and broad, occupying the shoulder slope. Pillar with two very oblique weak median plaits. Range — Known only from the Otaian and Awamoan middle and upper Oligocene of New Zealand.

#### CHARACTERISTIC SPECIES—

*nodosoliratus* (Suter, 1917), *vexilliformis* (Marshall & Murdoch, 1923).

Genus HELENELLA Casey, 1904,

Trans. Acad. St. Louis 4, p. 167. Type (s.d. Dall, 1918) *Pleurotoma multigranosa* E. A. Smith, 1890.

#### Plate 10, fig. 10

Shell small, 3-4 mm., biconic, narrowed anteriorly to an unnotched termination. Protoconch of two smooth whorls, the tip planorbid and tilted, the second whorl lightly convex, and passing directly into the adult sculpture, which is of heavy flat-topped spiral cords, cut into squarish nodules by numerous axial grooves. Aperture narrow; outer lip thin at the edge, strengthened behind but not variced, and weakly lirate to dentate within. Sinus subsutural, an oblique shallow but distinct excavation in the posterior apertural callus. Inner lip with two distinct median plications. Colour white, irregularly tessellated with reddish-brown; tessellations more numerous on the base, giving a zoned appearance. Range — Known only by two Recent species from St. Helena, *multigranosa* (E.A. Smith, 1890) and *insolens* Casey, 1904.

Judging from its well-formed pillar plaits the genus is probably nearer allied to *Mitrolumna* than to *Mitromorpha*, but differs from both in having a more definite sinus.

Genus ZETEKIA Dall, 1918,

Proc. U.S. Nat. Mus. 54, no. 2238, p. 320. Type (o.d.) *Zetekia denticulata* Dall, 1918 (rather inadequately described). Dall, 1919, Ibid. 56, no. 2288, p. 73, pl. 1, fig. 1 (possible the genus and species should date from here).

#### Plate 10, fig. 9

Shell small, 6 mm., solid, *Mitromorpha*-like. Protoconch very small, of three translucent whorls. Adult sculpture of strong flattish closely spaced spiral cords, which are cut into squarish granules by numerous axial grooves. Aperture rather small and narrow with a short distinctly notched anterior canal. Outer lip thickened,



dentate within, and excavated above by a distinct rounded subsutural sinus. Inner lip bearing four or five weak pustular lirations on the outer edge of the columellar callus. Colour purplish-brown. The genus *Mitromorpha* has the pillar plications obsolete, an unnotched anterior canal and the adult sculpture is of spirals only. Range — Recent, Panama.

#### CHARACTERISTIC SPECIES—

*gemmulosa* (C. B. Adams, 1852) (= *denticulata* Dall, 1919). A second species credited to the genus is the unfigured *Z. curta* Dall, 1920, also from Panama.

#### Genus ARIELIA Shasky, 1961,

Veliger 4, 1, p. 20. Type (o.d.) *Arielia mitriformis* Shasky, 1961.

#### Plate 10, fig. 11

Shell small, 12.5 mm., narrowly biconic-fusiform. Protoconch planorboid of  $1\frac{1}{2}$  smooth whorls. Adult sculpture of numerous long axial fold-like ribs, overridden by closely spaced relatively strong rounded spiral cords. Aperture long and narrow, about half the height of the shell, terminating in a short undifferentiated, unnotched anterior canal. Outer lip thin, lirated within, and with a shallow but distinct daphnellid-like sutural sinus. Inner lip without a parietal callus pad, but with two distinct, medially located, pillar plaits. Colour dull white broadly banded with brown. Range — Known only by the type species which is from the Gulf of California in 40-90 fathoms.

The author of this genus likened it to *Zetekia*, which is a much smaller shell, with a shorter, more open aperture, and 4-5 lirations on the pillar.

#### Genus APATURRIS Iredale, 1917,

Proc. Malac. Soc. 12(6), p. 329. Type (o.d.) *Mitromorpha expeditionis* Oliver, 1915.

#### Plate 10, fig. 12

Shell small, 5-5.2 mm., ovate-biconic, with the spire and aperture height subequal. Protoconch of  $1\frac{1}{2}$  smooth whorls. Adult sculpture of low axial ribs, sinuous near the suture, and obsolete below the periphery of the body-whorl, the whole overridden by close regular spiral threads. Aperture narrow, terminated in a short unnotched anterior canal. Outer lip slightly thickened, interrupted above by a deep subsutural, subtubular, rimmed, U-shaped sinus. Columella flattened and bearing two obscure plications near the middle. The colour varies from white to buff and most shells have a few irregular brown maculations. Range — Known only by the type species which is from Raoul or Sunday Island, Kermadec Islands in 10-30 metres.

The genus is placed near *Mitromorpha* on account of the pillar plications but the deep sinus separates it from that genus and its allies.

#### Genus LOVELLONA Iredale, 1917,

Proc. Malac. Soc. 12 (6), p. 329. Type (o.d.) *Conus atramentosus* Reeve, 1849.

#### Plate 10, fig. 13

Shell small, 5-6 mm., solid, *Conus*-like, with a broad low conical spire, a narrowly rounded periphery, and then tapered with straight outlines to a narrow, very weakly emarginate, but undifferentiated anterior canal. Aperture long and narrow; outer lip thin, with no apparent sinus, just a slight broad insinuation over the shoulder slope. Inner lip straight and devoid of either callus or processes. Protoconch paucispiral, smooth, broad and almost flat, of  $1\frac{1}{2}$  whorls. Adult sculpture of flat-topped rather broad spiral cords, separated by narrow grooves. Regular axial threads in the interspaces, but not on the spiral cords. The effect is of linear punctate spiral grooves separating the cords. Colour dark brown to ashy-black with irregular peripheral spots, and a white anterior end. The radula (Orr, 1959, *Nautilus* 72(3), p. 77, fig. 1) is almost identical with that of *Mitromorpha carpenteri* Glibert, 1954 (= *flusa* Carpenter, 1865), that is, toxoglossate; a pair of simple slender marginals, without barbs, slightly constricted in the middle and with a spreading spatulate base (text fig. E122). Range — Recent, Indo-Pacific, Zanzibar, Philippines, Hawaiian Islands and Queensland.

The genus is allied to *Mitromorpha*, but that genus is ovate-biconic, has a taller and narrower depressed-papillate protoconch, and a smooth parietal callus. In *Lovellona* there is no parietal callus and the spiral cords pass strongly over the whole of the inner lip.

#### CHARACTERISTIC SPECIES—

*atramentosus* (Reeve, 1849), *micarius* (Hedley, 1912), *peaseana* Finlay 1927 (= *parvus* Pease, 1868 = *fusiformis* Pease, 1860).

#### Genus MAORIMORPHA Powell, 1939,

Rec. Auck. Inst. Mus. (2) (4), p. 235. Type (o.d.) *Mitromorpha suteri* Murdoch, 1905.

#### Plate 10, fig. 14

Shell minute, 4.6 mm., narrowly subcylindrical, with a relatively large paucispiral protoconch, tall spire, short narrow aperture, with a thin outer lip and a very short widely open and very feebly notched anterior canal. Sinus subsutural, broad and shallow, but distinct. Protoconch blunt, papillate, of  $1\frac{1}{2}$  smooth whorls, the initial whorl askew and inrolled. Adult sculpture of moderately strong flattened spiral lirae, continuous over all the post-nuclear whorls, right to the anterior end, and crossed by weak rather distant rounded fold-like axials. No apertural denticles or processes of any kind. Colour white to light reddish brown. The genus somewhat resembles *Mitri-thara*, but is much more slender, has a relatively larger but fewer whorled protoconch,



and lacks the characteristic columellar plicae. Range — the southern part of the South Island of New Zealand, 15-72 fathoms.

CHARACTERISTIC SPECIES—

*secunda* Powell, 1942, and *suteri* (Murdoch, 1905).

Genus AWATERIA Suter, 1917,

N.Z. Geol. Surv. Pal. Bull. 5, p.57. Type (o.d.) *Awateria streptophora* Suter, 1917.

Plate 10, fig. 15

Shell small to moderate sized, 4-15 mm., ovate-biconical to narrowly ovate, boldly sculptured with strong rounded axial ribs, crossed by moderate to strong spiral cords, the strongest being a subsutural fold, which is almost invariably rendered nodulose by the axials. Below the subsutural fold there is a deep but narrow shoulder sulcus, across which the axials are much reduced in strength. The peripheral spiral is often as strong or stronger than the subsutural fold. Protoconch smooth, "of 1½ carinated whorls, the tilted pullus minute, its little apex erect, then immersed into the spire, rising again, leaving a semicircular depression" (Suter, l.c.p. 57). Sinus shallow, with widely divergent sides, its apex a slight narrow indentation at the shoulder sulcus. Aperture ovate, terminated in a short oblique unnotched anterior canal. Range — New Zealand, Miocene to Pleistocene.

The four species of Smith (1891, Proc. Zool. Soc. pp. 438, 439), *Pleurotoma* (*Drillia*) *challengeri*, *crossei*, *hoylei* and *watsoni*, all from the discredited "Challenger" station, stated to have come from 410 fathoms off Sydney, were referred to *Awateria* by Hedley (1922, Rec. Aust. Mus. 13, 6, pp. 232, 233), but from the descriptions and rather poor figures it would seem that not one of Smith's species belong to *Awateria*, nor has anything resembling these species since been found in Australian waters.

The genus resembles *Scrinium* but has stronger sculpture, a heavy subsutural fold, followed by a deep narrow shoulder sulcus, and the sinus is more definite.

CHARACTERISTIC SPECIES—

*Miocene-defossa* Powell, 1942, *marwicki* Powell, 1942, *miocenica* Vella, 1954, *striata* Vella, 1954. *Pliocene-echinata* Powell, 1942, *evanida* Suter, 1917, *streptophora* Suter, 1917, *thomsoni* and *wairoaensis* Powell, 1942. *Pleistocene-mollyae* and *retiolata* King, 1933.

Subgenus MIOAWATERIA Vella, 1954 (of *Awateria*),

Trans. Roy. Soc. N.Z. 81 (4), p. 552. Type (o.d.) *Awateria personata* Powell, 1942.

Plate 10, fig. 16

Shell small, 7-9 mm., of light build, distinguished from *Awateria* typical, by its wider more gently sloping shoulder, much narrower moniliform subsutural fold, and narrow peripheral carina, rendered nodulose by the axials,

which commence abruptly there and continue over the base. Protoconch dome-shaped of about 1½ whorls, the tip a little excentric, smooth, except for a few faint axial riblets over the last quarter whorl. Aperture ovate-pyriform, terminated in a relatively long, flexed, spout-like, unnotched anterior canal; outer lip thin; sinus obsolete; inner lip a light spreading callus. Range — The Altonian upper Oligocene to the Opoitian lower Pliocene of New Zealand.

The subgenus has a superficial resemblance to the North Atlantic genus *Gymnobela*.

CHARACTERISTIC SPECIES—

*Oligocene-expallata* and *experta* Laws, 1947. *Miocene-pahoaensis* Vella, 1954. *Pliocene-karakaensis* Marwick, 1931 and *personata* Powell, 1942.

Subfamily CLAVINAE Powell, 1942

Shells of moderate size, almost invariably slender, with a tall spire, but a truncated anterior canal. The sinus is upon the shoulder slope, U-shaped, shallow to moderately deep, and often rendered subtubular when a strong entering parietal tubercle is present.

The subfamily is distinctive since it is the only one that has members exhibiting the prototypic dentition, which is 1+1+1+1+1, consisting of a vestigial central tooth, broad comb-like laterals and a pair of long narrow marginals.

The clavinids are widely and abundantly distributed, and have a known range back to the Upper Cretaceous, but doubtless they have had a much earlier beginning, and may be considered nearer to the hypothetical primitive turrid than any of the other subfamilies.

Although the radula is considered to be prototypic for the family, it is by no means primitive, for the poison gland is almost as well developed in the prototypic radula as it is in those that have achieved the fully developed toxoglossate state.

Several radula types are represented in the Clavinae, and individually they do not appear to be associated with any particular form of shell, except that in a subtle way the prototypic clavinids can often be recognised by their robust build, much truncated anterior end, simple U-shaped sinus, and sculpture of bold axials, usually with a polished or weakly spirally sculptured surface. Other types of radulae found in the Clavinae are the long slender hypodermic-pointed marginals of *Tomopleura*, the similar but barb-tipped marginals of *Phenatoma*, the short stout barb-tipped marginals of *Inquisitor*, the awl-shaped marginals of *Microdrillia*, and the massive elongate-elliptical marginals, overlaid by a slender subsidiary member, in *Crassispira*.

Genus CLAVUS Montfort, 1810,

Conchyl. Systém. 2, p. 435. Type (o.d.) *Clavus flammulatus* Montfort, 1810 (= *Clavatula scabra*

Montfort, 1810. nom. nud. = *Clavatula echinata* Lamarck, 1816). Syns. *Clavicantha* Swainson, 1840, Treat. Malac. pp. 155, 314. Type (s.d. Herrmannsen, 1846) *Clavatula echinata* Lamarck, 1816. *Tylotia* Melvill, 1917, Proc. Malac. Soc. 12, p. 160. Type (o.d.) *Strombus canicularis* Röding, 1798 (= *Pleurotoma auriculifera* Lamarck, 1822). *Eldridgea* Bartsch, 1934, Smithsonian Misc. Coll. 91 (2), p. 2. Type (o.d.) *Eldridgea johnsoni* Bartsch, 1934. *Aliceia* Dautzenberg & Fischer, 1897, Mém. Soc. zool. France 10, p. 182. Type (monotypy) *Aliceia aenigmatica* Dautzenberg & Fischer, 1897.

*Plate 10, figs. 17-21*

Several names are involved in this group, which ranges from species with simple pointed solid tubercles (typical *Clavus*) to others, either with long hollow peripheral spines (*Tylotia*), or with prominent lamellate winged processes (*Eldridgea*).

A second species from the Caribbean, *Tylotia cadenasi* Clench & Aguayo, 1939, has the axial processes even further produced than in *Eldridgea johnsoni* Bartsch, 1934, but not so wing-like, being mostly peripheral, thus approximating extreme examples of *Clavus canicularis* (Röding, 1798).

Still another generic name is involved, and that is *Aliceia* Dautzenberg & Fischer, 1897, type, a deep water juvenile shell from off the Azores. This shell exhibits hollow peripheral spines also and is probably a *Clavus*, but this can be determined only on the basis of adult material at present unavailable.

The only obvious subdivision of the above complex could be *Clavus* for shells with solid spinose tubercles, and *Tylotia* (= *Eldridgea* = ?*Aliceia*) for shells with hollow spinose to wing-like axials. Against this, however, is the fact that *canicularis*, the type of *Tylotia*, goes through a solid spinose stage. Neither can two genera be segregated upon biogeographic grounds, for *canicularis* is Indo-Pacific and *Eldridgea* plus *Aliceia*, deep-water in the Caribbean and South Atlantic.

Shell of moderate size, 10-45 mm., with a rather tall spire and a truncated anterior end. Adult sculpture typically of prominent peripheral axials, which are either rounded to sharply pointed solid tubercles, or they may be considerably produced into long recurved hollow peripheral spines (*canicularis*), or even wing-like, thin, considerably expanded axial processes (*johnsoni*); spiral sculpture obsolete. Protoconch small, smooth, paucispiral, dome-shaped, of less than two whorls, and passing into the adult sculpture without a varix or brephic stage. Shoulder slope wide and usually steeply descending. Sinus wide and moderately deep, occupying most of the shoulder slope. Outer lip thin, with a well defined stromboid notch. Anterior canal short, scarcely differentiated, widely open and broadly shallowly notched. The outer lip, between the sinus and the stromboid notch projects as a claw-like process. There is a moderate to heavy entering parietal callus pad. Coloration, spotted and

flamed in brown on a pale ground, with several broad brown bands, or the whole of the base may be brown zoned. Radula (*canicularis* & *johnsoni*; text figs. D 84-86), prototypic, with a minute unicuspid central tooth, broad shallow arcuate multicuspid laterals, and long slender curved narrowly pointed marginals. Operculum ovate to leaf-shaped with a terminal nucleus (*canicularis* and *unizonalis*). Range — Recent, Indo-Pacific, from the Persian Gulf to the Philippines, Japan and the south-west Pacific, Puerto Rico, 200-300 fathoms, off Cuba, 180 fathoms, off the Azores, 743-1010 fathoms; and the Pliocene of Java. Mostly in the shallow waters of coral reefs and sandy flats.

CHARACTERISTIC SPECIES—

Recent; INDO-PACIFIC; *aglaia* (Dall, 1918) (= *crassa* Smith, 1888), *beckii* (Reeve, 1843), *berenice* (Dall, 1918) (= *spinosa* Smith, 1882), *bilineata* (Reeve, 1845), *canicularis* (Röding, 1798) (= *auriculifera* Lamarck, 1822), *coffea* (Smith, 1882), *exasperata* (Reeve, 1843), *flammulatus* Montfort, 1810 (= *echinata* Lamarck, 1816), *fusconitens* (Sowerby, 1901), *obliquata* (Reeve, 1845), *putillus* (Reeve, 1845), *unizonalis* (Lamarck, 1822), *vidua* (Reeve, 1845), *wilmeri* (Smith, 1875). ATLANTIC; *aenigmatica* (Dautzenberg & Fischer, 1897), *cadenasi* (Clench & Aguayo, 1939), *johnsoni* (Bartsch, 1934). Pliocene-*tjibaliungensis* (Martin, 1895).

Subgenus **PLAGIOSTROPHA** Melvill, 1927 (of *Clavus*),

Proc. Malac. Soc. 17, p. 151. Type (monotypy) *Plagiostropha quintuplex* Melvill, 1927.

*Plate 10, fig. 22*

Shell small, 11 mm., attenuately fusiform, with a tall spire, almost twice the height of the aperture, and a truncated body-whorl, ending in a very short straight broadly notched anterior canal. Protoconch pupoid of two glossy whorls. Adult sculpture of distant long protractive narrowly crested axial folds, five on spire whorls, which line up from whorl to whorl, and give a gentle spiral twist to the whole spire. Viewed from above the whorls exhibit a pentagonal form. On the body-whorl the axials are even wider spaced and number only three or four, resulting in a breaking up of the rib alignment. Surface smooth to very finely striated, except for the neck and the anterior end, which has a few moderately distinct spiral lirae. Aperture small; outer lip slightly thickened but not variced. Sinus subsutural, wide and deep. Parietal callus described as bulbous.

The type species recalls *opalus* and *ebur*, both of Reeve, 1845, which have a similar arrangement of protractive spirally continuous axial ribs. The type locality of *opalus* is Philippine Islands, that of *ebur* uncertain and that of *quintuplex* unknown.

The group seems to merit subgeneric separation on account of the curious continuity of the ribbing from whorl to whorl in an overall spiral manner.



Genus *TYLOTIELLA* Habe, 1958,  
*Venus*, 20 (1), p. 52. Type (o.d.)  
*Drillia subobliquata* Smith, 1879.

Plate 10, fig. 23

Shell of moderate size, 9-18 mm., rather solid, claviform, tall spired, but with a truncated body-whorl, and a short, wide feebly emarginated anterior canal. Protoconch blunt, smooth and paucispiral. Adult sculpture of long rounded fold-like, slightly oblique axials, extending from suture to suture and partly over the base, weaker over the shoulder sulcus, and nowhere developed into peripheral nodes or tubercles. Outer lip with a moderately deep subtural U-shaped sinus, somewhat constricted at its entrance by a thickened parietal callus pad. The colouring appears to be dark brownish, with subcentral band of paler colour: Radula (text fig. D93, 94) prototypic, consisting of a small narrow-based central tooth, with a central cusp and three denticles on each side of it, a pair of wide shallow curved multicusp lateral, and a pair of short rather stout dart-shaped marginals. The genus differs from *Clavus* in having a taller spire, longer axials, not produced into peripheral tubercles or processes, and in a slightly different radula; in typical *Clavus* the central tooth lacks the side denticles and the marginals are long, curved and slender. Range — Recent, Japan, India, Indonesia and Loyalty Islands.

CHARACTERISTIC SPECIES—

*humilis* (Smith, 1879), *pica* (Reeve, 1843), *sacra* (Reeve, 1845), and *subobliquata* (Smith, 1879).

Genus *DRILLIA* Gray, 1838,  
*Ann. Mag. Nat. Hist.* 1, p. 28. Type (s.d. Gray, 1847) *Drillia umbilicata* Gray, 1838.

Plate 11, fig. 1

Shell moderately large, 25-30 mm., very solid, elongate-conic, with a tall spire but a truncated body-whorl, which terminates in a bulging twisted fasciole, a pronounced false umbilical cavity, and a very short but deeply notched anterior canal. Protoconch narrowly conic of three smooth whorls, tip small. Adult sculpture of heavy broad but narrowly crested oblique axial ribs, which commence at the shoulder angle and extend over the base to the fasciole. Spiral sculpture of numerous weak flat-topped cords, with incised linear interspaces. The shoulder slope is smooth except for the sinus-curve growth lines. Outer lip thin edged but strengthened behind by a varicose axial. The sinus is on the shoulder slope, moderately deep, U-shaped, with a spout-like reflected rim, and somewhat constricted by a very heavy parietal callus pad. Most of the parietal callus is free along its outer edge. There is a very distinct stromboid notch, low on the outer lip. The radula (text figs. D 76, 77) is prototypic, with a minute unicuspid central, a crescentic comb-like lateral and an

elongated, sharply pointed, but not barbed, marginal. Operculum leaf-shaped, with a terminal nucleus. Colour uniformly buff, dull surfaced, often rust-brown stained, but the aperture and callus are porcellaneous white. Range — The genus is mainly of tropical West African distribution but it seems to extend to South African waters as well. Most of the South African species attributed to the genus, however, do not exhibit a false umbilical cavity. Barnard (1958, *Ann. S. African Mus.* 44, pp. 118-138) listed a large number of species but each will require careful evaluation before being admitted to the genus. It does appear, however, that at least one Indian Ocean species may qualify for inclusion in *Drillia*, being of very similar facies, including a noticeable false umbilicus; the radula, however, is unknown—i.e. *aglaia* (Dall, 1918) (= *crassa* Smith, 1888).

CHARACTERISTIC SPECIES—

WEST AFRICA, Recent—*angolensis* Odhner, 1923; *ballista* Maltzan, 1883; *bruuni* Knudsen, 1952; *dakarensis* Knudsen, 1956; *distincta* Thiele, 1925; *dunkeri* Knudsen, 1952, *monodi* Knudsen, 1952; *nicklesi* Knudsen, 1956; *pyramidata* (Kiener, 1839-40); *rosacea* (Reeve, 1845) (= *rosolina* Marrat, 1877); *subcontracta* Smith, 1904; *tripter* Maltzan, 1883 and *umbilicata* Gray, 1838. Also, a West African Tertiary species has been described, *paucinoda* Douvillé, 1933.

The genus name *Drillia* has been used very extensively in a conventional manner, to cover any sort of turrid with a tall spire and a truncated body-whorl, from Recent and Tertiary localities in most parts of the world.

Genus *CLATHRODRILLIA* Dall, 1918,

*Proc. USNM*, 54, no. 2238, p. 323. Type (o.d.) *Pleurotoma gibbosa* "Reeve" = Born, 1778.

Plate 11, fig. 2

Shell of medium to large size, 20-50 mm., fusiform, with tall turreted spire and truncated body-whorl, a flared outer lip, then rapidly tapered to a very short recurved and deeply notched anterior canal. There is a distinct stromboid-notch in the lower outer lip. The sculpture consists of a strong subsutural cord followed, after a deep narrow rather smooth shoulder sulcus, by numerous axials, crossed by numerous spiral cords. A feature of this genus and also of *Imaclava* is a heavy rounded varix at about one-third of a whorl back from the aperture. The sinus is moderately deep and wide, occupying most of the shoulder slope. Protoconch of 2-2½ smooth whorls. The coloration is of irregular reddish-brown maculations on a greyish-buff ground; two relatively wide brown spiral bands on the base, being much darker on the varix. Range — Recent, Florida, Caribbean and Gulf of California to Ecuador. The genus has been recorded from the lower Oligocene of Peru, the Miocene of Maryland, Virginia, Florida, San Domingo, Jamaica, and Venezuela and the Pliocene of Florida, Costa Rica and Ecuador, but I am unable to verify



these claims until the relevant material is examined. The genus has been used widely for Indo-Pacific species that would be better placed in *Inquisitor*. Kiener, 1939-40, Icon. Coq. Viv., p. 35, erroneously attributed *gibbosa* to the Indian Ocean. The hump-backed variced body-whorl is considered diagnostic of this genus and the closely allied *Imaclava*.

#### CHARACTERISTIC SPECIES—

*gibbosa* (Born, 1778), *callianira* (Dall, 1919), *inaequistriata* (Li, 1930) (= *perla* M. Smith, 1947), *maura* (Sowerby, 1834), *ostrearum* (Stearns, 1872), *paziana* Dall, 1919 and *pilsbryi* Lowe, 1935.

#### Subgenus IMACLAVA Bartsch, 1944 (of *Clathrodrillia*),

Proc. Biol. Soc. Wash., 57, p. 26. Type (o.d.) *Lima* Bartsch, 1944 = *Clavus pembertoni* Lowe, 1935.

##### Plate 11, fig. 4

Shell rather large, 40-50 mm., fusiform with tall turreted spire but truncated body-whorl, with a short flexed, deeply notched anterior canal and flared outer lip at the periphery. Protoconch small of two smooth depressed rounded whorls. Adult sculpture of weak spiral lines and a row of peripheral nodes. The suture is unmarginated. A feature common to this subgenus and to *Clathrodrillia* is a heavy broadly rounded varix, one-third of a whorl back from the aperture. Sinus deep, rather wide, with a broadly rounded apex but somewhat constricted above by a massive parietal callus pad. There is a distinct stromboid-notch in the lower part of the outer lip. Operculum oval with a terminal nucleus. Radula (text fig. D89) prototypic, central tooth a minute vestigial plate, lateral broad, lunate, strongly denticulate and marginal long, slender, flexed, dagger-shaped, with a small accessory plate at the basal end. Coloration, irregularly maculated in reddish-brown on a pale ground, two banded on the base and darker on the varix, as in *Clathrodrillia*. Range — Sonora, Mexico to Panama.

#### CHARACTERISTIC SPECIES—

*pembertoni* (Lowe, 1935) (= *ima* Bartsch, 1944), *pilsbryi* Bartsch, 1950 and *unimaculatus* (Sowerby, 1834).

#### Genus KYLIX Dall, 1919,

Proc. U.S. Nat. Mus. 56, no. 2288, pp. 19, 20. Type (o.d.) *Clathrodrillia (Kylix) alcyone* Dall, 1919. Syn. *Kylix* Dall, 1918, Proc. U.S. Nat. Mus. 54, no. 2238, p. 327 (nom. nud., type not described until 1919).

##### Plate 11, fig. 3

Shell of moderate size, 13-19 mm., claviform, with a tall spire of rather flattened outlines, and a rounded body-whorl, contracted to a distinct neck, and a moderately long, slightly flexed, weakly to distinctly notched anterior canal. Protoconch of two polished prominently peripherally keeled whorls (*alcmena*). Adult sculpture of numerous rather flexuous fold-like axial ribs, deeply incised by spiral linear grooves. Sinus subsutural, rounded,

rather wide and with a slightly flaring edge. Outer lip thin; inner lip smooth callused, without, or with a very slight parietal callus pad. Radula (text fig. D87) — Prototypic, with a mere vestige of a central plate, a deep narrow-based comb-like lateral, and a long slender flexuous simple-pointed marginal, bifid basally and for two-thirds of its length (*alcmena*). Range — Recent, Gulf of California and West Mexico, 4-76 fathoms.

Dall proposed *Kylix* as a subgenus of *Clathrodrillia* but Myra Keen (1958, Sea Shells of Tropical West America, p. 452) made it a subgenus of *Clavus*. However, it is sufficiently distinct from both to merit generic status.

#### CHARACTERISTIC SPECIES—

*alcmena* and *alcyone* (Dall, 1919), *turveri* and *zacae* (Hertlein & Strong, 1951).

#### Genus NEODRILLIA Bartsch, 1943,

Mem. Soc. Cubana Hist. Nat. 17 (2), p. 83. Type (o.d.) *Neodrillia cydia* Bartsch, 1943.

##### Plate 11, fig. 5

Shell of moderate size, 10-23 mm., solid, elongate-conic, with a tall spire but a truncated body-whorl, which terminates in a moderate fasciole, without a false umbilical cavity, and a very short shallowly notched anterior canal. Protoconch of  $2\frac{1}{2}$  whorls, first  $1\frac{1}{2}$  smooth, succeeded by very closely spaced hair-like threads, followed by distant axials, later crossed by weak spiral striae. Adult sculpture of distant bluntly rounded strong axials, the whole surface crowded with linear-spaced strong threads. Sinus moderately deep, U-shaped, on the shoulder slope, somewhat constricted by a heavy parietal callus pad. Outer lip thin at the edge but strengthened behind by a varicose axial. The entire outer edge of the inner lip is sharply differentiated from the body-whorl. In the type species there is a spiral series of brown spots below the periphery, and each is located on an axial rib. The radula (text fig. D81) is prototypic, as in *Drillia*, with a vestigial central, a crescentic comb-like lateral and an elongated, flexuous, sharply pointed but not barbed marginal. The genus is close to *Drillia* but has a different protoconch and lacks a false umbilical cavity. Range — Florida and the islands of the Caribbean in 25 to 150 fathoms.

#### CHARACTERISTIC SPECIES—

*cydia* Bartsch, 1943 (= *antiguensis*, *encia*, *barbadensis* and *jamaicensis* Bartsch, 1943); *euphanes* (Melvill, 1923).

#### Genus CERODRILLIA Bartsch & Rehder, 1939,

Proc. U.S. Nat. Mus. 87, no. 3070, p. 127. Type (o.d.) *Cerodrillia clappi* Bartsch & Rehder, 1939.

##### Plate 11, fig. 6

Shell small, 11-13 mm., elongate-fusiform, with a tall spire of medially weakly angulated whorls, and an ovate body-whorl, slowly



tapered to a very short broadly channelled but unnotched anterior canal. Protoconch of two smooth rounded whorls, passing directly into the post-nuclear sculpture without a brephic stage. Adult sculpture of prominently broadly rounded protractive axials which extend from suture to suture and over most of the base. A weak median angulation slightly carinates the axials. Surface with very fine spiral lirae, increasing to noticeable threads on the base and anterior end. Outer lip thin edged, with a deep broadly U-shaped sinus, occupying most of the shoulder slope, somewhat constricted at its entrance by a relatively strong parietal callus pad. The outer lip is produced forward in a claw-like fashion below the sinus, and has a feeble stromboid notch towards the anterior canal. Colour varying between yellowish-white, with a peripheral pale brown band, to uniformly brown. The radula (*thea* Dall, 1883; text fig. D90) is prototypic, with a small narrow unicuspid central tooth (varying to vestigial), comb-like laterals and long narrow slender pointed marginals. Range — Recent, Florida and Puerto Rico in shallow water.

The genus seems to be related to *Neodrillia*, which also has a prototypic radula, but with differently shaped marginals. Also the protoconch in *Neodrillia* has the addition of axial and spiral sculpture on the last whorl, the anterior canal is notched, and the adult surface is crowded with strong spiral threads as well as having bold broadly rounded axials. Another genus of somewhat similar appearance, *Viridrillia*, has a different protoconch, ending in axial riblets, a distinctly notched anterior canal, and a very different radula, which consists only of a pair of elongate foliated marginals.

#### CHARACTERISTIC SPECIES—

*clappi* and *perryae* Bartsch & Rehder, 1939, *thea* (Dall, 1883).

#### Subgenus LISSODRILLIA Bartsch & Rehder, 1939 (of *Cerodrillia*),

Proc. U.S. Nat. Mus. 87, no. 3070, p. 129. Type (o.d.) *Cerodrillia* (*Lissodrillia*) *schroederi* Bartsch & Rehder, 1939.

#### Plate 11, fig. 7

The subgenus was stated by its authors to differ mainly in the complete absence of spiral sculpture. The other characters cited, protoconch, axial sculpture, and the form of the aperture are closely similar to those features in the typical genus. Size 6-8 mm. Range: Recent — North Carolina to Florida, 15-28 fathoms, and the Pliocene of St Petersburg, Florida.

The figure of the type species provided by Bartsch and Rehder, is too small and indistinct for copying, so Fargo's illustration of his Pliocene *recticostata* is used to illustrate the subgenus.

#### CHARACTERISTIC SPECIES—

Recent—*schroederi* Bartsch & Rehder, 1939, *simpsoni* (Dall, 1887). Pliocene-*simpsoni* subsp. *recticostata* Fargo, 1953.

#### Genus VIRIDRILLIA Bartsch, 1943,

Mem. Soc. Cubana Hist. Nat. 17 (2), p. 91. Type (o.d.) *Viridrillia williami* Bartsch, 1943. Syn. *Viridrillina* Bartsch, 1943, Mem. Soc. Cubana Hist. Nat. 17 (2), p. 99. Type (o.d.) *Viridrillia* (*Viridrillina*) *hendersoni* Bartsch, 1943.

#### Plate 11, fig. 8

Shell small, 9-11 mm., elongate-ovate, with a tall spire, but a truncated body-whorl, ending in a short obliquely shallowly emarginate anterior canal. Anterior fasciole very weakly developed, and there is no false umbilical cavity. Protoconch of 2½ whorls, tip smooth, remainder with numerous axial ribs, crossed by strong spiral cords on the last whorl, resulting in a gemmate reticulation. Adult sculpture of bluntly rounded axials and the whole surface crossed by closely spaced fine to relatively strong spiral threads. Apertural features similar to those of *Neodrillia*, but the shells are smaller, of narrower build, and have a differently sculptured protoconch. Bartsch's subgenus *Viridrillina* differs only in having weaker spiral sculpture. It is too closely allied to the genus to deserve recognition. Colour white to uniformly pale brownish. Range — Western Atlantic, at moderate depths from the Carolinas to Florida and the Bahamas.

#### CHARACTERISTIC SPECIES—

*cervina*, *bahamensis*, *hendersoni* and *williami* Bartsch, 1943.

#### Genus ELAEOCYMA Dall, 1918,

Proc. U.S. Nat. Mus. 54, no. 2238, p. 326. Type (o.d.) *Drillia empyrosia* Dall. 1899.

#### Plate 11, fig. 9

Shell moderately large, 13-45 mm., solid, claviform, with a very tall spire of relatively straight outlines, and a short body-whorl, quickly contracted to a short, slightly twisted and recurved, deeply notched anterior canal, with a ridge-margined fasciole. Protoconch small, but narrow and erect, of 2½ smooth whorls, the last two angulate to carinate below the middle. Adult sculpture of protractively oblique and flexuous axial folds, which are weak and deeply concave over the shoulder area, strongest at the periphery, and again more or less reduced over the base. Surface finely lirate over the shoulder slope, but with much stronger spirals from the angulation downward. Aperture rather broadly ovate, slightly flared, constricted to the short anterior canal. Outer lip thin edged but strengthened behind by the nearest axial fold. Sinus very deep, U-shaped, on the shoulder slope, considerably restricted at its entrance by a massive parietal callus pad; remainder of the outer lip produced forward in claw-like fashion, and

with a deep stromboid notch below. Radula (*empyrosia* Dall, 1899 and *halocyadne* Dall, 1919; text figs. D91, 92), prototypic, with a vestigial unicuspid central tooth, comb-like laterals, and long slender simple pointed marginals. Colour of the type species yellowish-brown, with a pale yellowish peripheral band. Range — Recent, California to Ecuador. Also recorded from the Eocene to the Pleistocene of Europe by Glibert (1960, Mem. Inst. Roy. Sci. Nat. Belg. 64, pp. 51, 52) and the Pliocene of Japan by Otuka (1937, Venus, 7, 3, p. 141), but all these claims require confirmation; the Japanese Pliocene species, however, appears to be a *Clavus*.

The genus appears to be very closely allied to *Cymatosyrinx*. Both have a paucispiral medially carinate, otherwise smooth, protoconch, a flared aperture, its outer edge produced, claw-like, a very distinct stromboid notch, and a massive parietal callus-pad, which considerably constricts the entrance to the deep subsutural sinus; *Elaeocyma*, however, may serve to differentiate species with rather straight-sided whorls, tending to have a sagged appearance, and without a subsutural margining fold.

#### CHARACTERISTIC SPECIES—

*abdera* Dall, 1919, *acapulcana* Lowe, 1935, *aegina*, *aeolia*, *aerope* and *attalia* Dall, 1919, *clavata* (Sowerby, 1934), *craneana* Hertlein & Strong, 1951, *empyrosea* (Dall, 1899), *halocyadne* and *ianthe* Dall, 1919, *impressa* and *micans* (Hinds, 1843), *salvadorica* Hertlein & Strong, 1951.

#### Genus SPIROTROPIS G. O. Sars, 1878,

Moll. Reg. arct. Norveg. 10, p. 242. Type (monotypy) "*Spirotropis carinata* Philippi = "*Pleurotoma carinatum* Philippi, 1844.

#### Plate 11, figs. 10, 11

Shell of moderate size, 10-18 mm., rather thin, fusiform, with a tall spire of strongly angulated or carinated whorls, and a rather short body-whorl, produced into a rather short, straight, unnotched anterior canal. The protoconch is relatively large, bluntly rounded to globose, of  $1\frac{1}{2}$ -2 smooth whorls, ending in a forwardly inclined concavely arcuate slight rim. Adult sculpture, typically, with medially carinate whorls, otherwise smooth except for some weak very oblique peripheral nodes on the early post-nuclear whorls. Aperture pyriform. Outer lip thin edged, with a broadly rounded, rather deep U-shaped sinus, occupying the whole of the shoulder slope, and merged below in a great forward arcuate swing of the lip. Inner lip a smooth callus with a weakly defined edge. Operculum leaf-shaped with a terminal nucleus. Radula (text fig. D83) prototypic, with a small oval-based unicuspid central tooth, a comb-like lateral, and a long slender-pointed marginal, with a bifid, somewhat foliated basal extremity. Range — (typically), Recent — New England to Scandinavia to the Mediterranean and Canary Islands, mostly in deep

water, down to over 2000 fathoms. Also Pleistocene, Pliocene and Miocene of Europe (more or less typical; more pronounced axial sculpture), Recent — Kerguelen Island and Enderby Land, Antarctica.

The genus has been recorded also from the Eocene to Recent of North-West America but I have not been able to verify these claims. Some species of *Rectiplanes*, which have a turritid sinus and radula have been confused with *Spirotropis*, as also have several Japanese species which belong to the turriculinid genus *Makiyamaia*.

#### CHARACTERISTIC SPECIES—

(N. Atlantic and Europe) — *clytotropis* Sykes, 1906, *ephamilla* Verrill, 1884, *melvilli* Sykes, 1906, *modiolus*, Cristofori & Jan, 1832) (= *acuta* Bellardi, 1842 = *carinata* Bivona, 1838 = *scalaris* Partsch, 1837), *monterosatoi* (Locard, 1897). (Subantarctic and Antarctic) — *remota* Powell, 1958, *studeriana* (Martens, 1878).

#### Genus CRASSISPIRA Swainson, 1840,

Treat. Malacol, pp. 152, 313. Type (s.d. Herrmannsen, 1847) *Pleurotoma bottae* Kiener, 1839-40

#### Plate 11, fig. 12

Shell of moderate to large size, 12-50 mm., mostly dark brown or black, elongate-fusiform, but with a more or less truncated anterior end. Sculptured with a broad flat subsutural fold, usually smooth, sometimes nodulose, bounded below by a sharp raised edge. Concave sinus area usually smooth except for sinus growth stages. Protoconch paucispiral, smooth at first, then developing axial riblets. Adult sculpture of stout axials, commencing at the shoulder and usually extending well over the base, overridden to some extent by spiral cords. In some species the axials are nodulose over the peripheral area. Sinus moderately deep, U-shaped, occupying the shoulder concavity between the subsutural margin and the shoulder angle. Outer lip not variced but with a very shallow stromboid notch. In the type species the body-whorl is rather long and narrow, with a short widely open and rather deeply notched anterior canal. Other species, such as *nigerrima* Sowerby, have the base truncated, and the short anterior canal deeply notched at the termination of a distinct rather bulging fasciole. Operculum ovate, with a terminal nucleus. Radula, a pair of marginals only, elongated, rather narrow and more or less parallel sided, abruptly tapered to a sharp point; a narrow, much smaller accessory plate is superimposed on the lower part of the main tooth. This no doubt has been derived from one of the basal extensions of an original "wishbone-type" marginal. Range — Recent, tropical West America, Lower California, the Galapagos, the Caribbean, and to a limited extent in the Indo-Pacific. Pleistocene, California and Lower California. Pliocene, Florida and Ecuador. Miocene, Florida and the islands



of the Caribbean, Mexico and Costa Rica. Oligocene, Florida and Mississippi. Eocene, Peru. Also recorded Recent from the Indo-Pacific and the Tertiary of Europe, Zanzibar, Burma, Java, Sumatra, Timor and Okinawa.

The genus name *Crassispira* has been widely applied or misapplied in a world-wide coverage from the Eocene to the present. Many of the Recent Indo-Pacific species can be more realistically located in other genera such as *Inquisitor*. There is a tendency to refer to *Crassispira* every species that exhibits a strong subsutural fold, but this feature is variable in development, even among undoubted species of *Crassispira*, and is also a common feature among turrids in general. Some Indo-Pacific species certainly appear to closely resemble *Crassispira*, notably *sundaica* and *sultana* of Thiele, 1925. However, three Indo-Pacific species at least have the *Crassispira* style of radula, i.e., *aesopus* (Schepman, 1913), *sinensis* (Hinds, 1843) and *tasconium* (Mellvill & Standen, 1901). The hub of distribution of the genus is now tropical West America, for which fauna 62 species are recognised.

#### CHARACTERISTIC SPECIES—

Recent — TROPICAL WEST AMERICA; *adamsiana* Pilsbry & Lowe, 1932; *albinodata* (Reeve, 1846); *albonodosa* (Carpenter, 1856); *albovallosa* (Carpenter, 1856); *amathea* Dall, 1919; *appressa* (Carpenter, 1864); *arsinoe* Dall, 1919; *aterrima* (Sowerby, 1834); *atramentosa* (Smith, 1882); *atrior* (C. B. Adams, 1852); *aureonodosa* Pilsbry & Lowe, 1932; *bacchia* Dall, 1919; *bicanalifera* (Sowerby, 1834); *bottae* (Kiener, 1839-40); *bridgesi* Dall, 1919; *brujae* Hertlein & Strong, 1951; *candace* Dall, 1919; *cerithioidea* (Carpenter, 1856); *chacei* Hertlein & Strong, 1951; *collaris* (Sowerby, 1834); *cornuta* (Sowerby, 1834); *dirce* Dall, 1919; *discors* (Sowerby, 1834); *epicasta* Dall, 1919; *erebus* Pilsbry & Lowe, 1932; *ericana* Hertlein & Strong, 1951; *erigone* Dall, 1919; *eurynome* Dall, 1919; *excentrica* (Sowerby, 1834); *flavocarinata* (Smith, 1882); *flavonodosa* Pilsbry & Lowe, 1932; *fonseca* Pilsbry & Lowe, 1932; *grandimaculata* (C. B. Adams, 1852); *hanleyi* (Carpenter, 1856); *hermanita* Pilsbry & Lowe, 1932; *incrassata* (Sowerby, 1834); *loxospira* Pilsbry & Lowe, 1932; *martinensis* Dall, 1919; *melchersi* (Menke, 1851); *nautica* Pilsbry & Lowe, 1932; *nigerrima* (Sowerby, 1834); *nymphia* Pilsbry & Lowe, 1932; *pluto* Pilsbry & Lowe, 1932; *rudis* (Sowerby, 1834); *rustica* (Sowerby, 1834); *solitaria* Pilsbry & Lowe, 1932; *tango-laensis* Hertlein & Strong, 1951; *tepocana* Dall, 1919; *tomliniana* Melvill, 1927; *trimariana* Pilsbry & Lowe, 1932; *turricula* (Sowerby, 1834); *xanti* Hertlein & Strong, 1951. CALIFORNIA; *montereyensis* (Stearns, 1871). FLORIDA; *phasma* Schwengel, 1940. CARIBBEAN; *drangai* Schwengel, 1951. INDO-PACIFIC; *aesopus* (Schepman, 1913); *sinensis* (Hinds, 1843) and *tasconium* (Mellvill & Standen, 1901). Pleistocene-*kluthi* Jordan, 1936; *zizyphus* (Berry, 1940); Pliocene-*guayana* Pilsbry & Olsson, 1941; *piscator* (Dall, 1890); *acurugata* (Dall, 1890). Miocene-*acclinica* (Tucker & Wilson, 1933); *aegis* and *annella* Woodring, 1928; *antealesidota* Mansfield, 1930; *aurantia* (Olsson, 1922); *blountensis* Mansfield, 1935; *boadicea* Dall, 1900; *bösei* Engstrand & Urbina, 1910; *calligona* (Maury, 1910); *calligonoides* Gardner, 1937; *callistura* (Pilsbry & Johnson, 1917); *capella* Olsson, 1930; *caroniana* Maury, 1925; *henikeri* (G. B. Sowerby, 1850); *jamaicensis* (Guppy, 1866); *laurentii* Gardner, 1947; *lomata* Woodring, 1928; *losquemadica* Maury, 1917;

*loxa* Gardner, 1947; *meunierei* (Maury, 1910); *paraconsors* Gardner, 1937; *ponida* Woodring, 1928; *starri* Hertlein & Jordan, 1927; *toulai* (Cossmann, 1913). Oligocene-*abundans* (Conrad, 1847); *kempi* (Maury, 1910). Eocene-*woodringi* Olsson, 1930.

Subgenus CRASSISPIRELLA Bartsch & Rehder, 1939 (of *Crassispira*),

Proc. U.S. Nat. Mus. 87, no. 3070, p. 135. Type (o.d.) *Turris rugitecta* Dall, 1918.

#### Plate 11, fig. 13

Shell moderately large, 20-25 mm., solid, claviform, with a tall spire but a truncated anterior end. A conspicuous feature of the subgenus is the massive sharply keeled subsutural margining spiral and the numerous prominent rounded axial ribs, overridden by strong spiral cords. Protoconch of one smooth rounded whorl, followed by a whorl or less or closely spaced axial riblets. Aperture narrowly ovate, terminated in a short widely open anterior canal, the wide shallow notch lying obliquely to the axis of the shell. Sinus moderately broad and deep, occupying most of the shoulder slope. Parietal wall covered by a moderately thick callus but not developed into an entering pad or tubercle. Colour dark brown often with a pale band or line at the periphery. Range — Recent — Lower California, Florida and the Caribbean, Pliocene of Florida and Miocene of the Dominican Republic. Typical *Crassispira* is more elongate-fusiform with a less prominent subsutural fold, but many species attributed to *Crassispira* tend towards *Crassispirella*.

#### CHARACTERISTIC SPECIES—

Recent — *fuscescens* (Reeve, 1843); *hadromeres* (Melvill, 1927); *nigrescens* (C. B. Adams, 1845); *rugitecta* (Dall, 1918); *sanibelensis* Bartsch & Rehder, 1939; *tampaensis* Bartsch & Rehder, 1939. Pliocene and Miocene-*ebenina* (Dall, 1890).

Subgenus MONILISPIRA Bartsch & Rehder, 1939 (of *Crassispira*),

Proc. U.S. Nat. Mus. 87, no. 3070, p. 137. Type (o.d.) *Monilispira monilis* Bartsch & Rehder, 1939.

#### Plate 11, fig. 14

Shell of moderate size, 7-16 mm., solid, elongated turreted spire but with a truncated anterior end. Adult sculpture of strong tuberculate spiral series of axials, a massive peripheral series and several others, less prominent, on the base. Suture submarginated by a distinct, narrow, but not massive fold. Protoconch of two smooth whorls followed by a third of curved axial riblets. Sinus deep, broadly U-shaped, on the shoulder slope. Aperture narrowly ovate, rapidly contracted to a short widely open very shallowly notched anterior canal. Tubercles light coloured on a dark brown to black ground. Operculum claw-shaped, with a terminal nucleus. The main difference from *Crassispira* and allied subgenera is in the revolving series of large tubercles. Range — Recent, tropical West



America, the Galapagos and Florida. Pliocene — Florida.

CHARACTERISTIC SPECIES—

Recent — *leucocyma* (Dall, 1883); *monilifera* (Carpenter, 1856); *monilis* (Bartsch & Rehder, 1939); *nephele* Dall, 1919; *ochsneri* (Hertlein & Strong, 1949) (= *bicolor* Sowerby, 1834). Pliocene-archeri Fargo, 1953.

Subgenus STRIOSPIRA Bartsch, 1950 (of *Crassispira*),

*Nautilus*, 63 (3), p. 95. Type (o.d.) *Crassispira lucasensis* Bartsch, 1950.

Plate 11, fig. 16

Shell small to medium sized, 13-20 mm., solid, claviform, uniformly dark brown to almost black, the surface densely spirally striate, and with a peripheral row of short erect to oblique nodulose folds. Sutural submarginating broad but low and indistinct. Aperture narrow with very short deeply notched anterior canal. Sinus moderately deep, U-shaped, on the lower part of the shoulder slope, immediately above the peripheral angulation, and constricted above by a massive parietal callus pad. Outer lip thin at its outer edge but variced from behind; a broad, very distinct stromboid notch towards the anterior end. Protoconch of three whorls, first two smooth and small, the last with protractively curved axial riblets. Operculum leaf-shaped with a terminal nucleus. Radula of marginals only, in which the basal limbs are approximated and fused (Bartsch). There is little to distinguish *Striospira* from the typical genus. Range — tropical West America.

CHARACTERISTIC SPECIES—

*cortezii* Shasky & Campbell, 1964; *lucasensis* (Bartsch, 1950); *luctuosa* (Hinds, 1843); *tabogaensis* (Bartsch, 1950); *unicolor* (Sowerby, 1834).

Subgenus PILSBRYSPIRA Bartsch, 1950 (of *Crassispira*),

*Nautilus*, 63 (3), p. 90. Type (o.d.) *Pilsbryspira pilsbryi* Bartsch, 1950.

Plate 11, fig. 17

Shell rather small, 12-12.5 mm., ovate, very solid and strongly sculptured with numerous heavy rounded axials, crossed by closely spaced strong spiral lirae. Colour yellowish-white, conspicuously banded with brown, one band occupying the shoulder slope, and two more on the base. Protoconch unknown. Aperture ovate, terminated below in a very short, apparently unnotched anterior canal, and with a variced outer lip. Sinus deep, U-shaped, on the lower part of the shoulder slope. A heavy parietal callus pad slight constricts the sinus from above. Suture submarginated by a slender spiral cord. Range — known only by the type species which is from Panama. Again, there is little to distinguish *Pilsbryspira* from the typical genus.

Subgenus DALLSPIRA Bartsch, 1950 (of *Crassispira*),

*Nautilus*, 63 (3), p. 92. Type (o.d.) *Dallspira dalli* Bartsch, 1950.

Plate 11, fig. 15

Shell of medium size, 14-17 mm., solid, claviform, dark brown, typically with two paler zones, subangled, with prominent peripheral axial nodes. Subsutural fold subobsolete. Protoconch of two smooth whorls followed by a whorl of protractive curved axial riblets. Aperture narrow, with a very short shallowly notched anterior canal. Sinus deep, U-shaped, somewhat contracted at its entrance by a massive parietal callus pad. Outer lip thin at its outer edge but variced from behind. Operculum elongate-ovate with a terminal nucleus. Radula, a pair of marginals; the lesser basal limb is a small elongate plate, superimposed on the basal part of an elongated much larger member, which has a simple sharp point. Range — Gulf of California to Panama.

CHARACTERISTIC SPECIES—

*dalli* (Bartsch, 1950); *lowei* (Bartsch, 1950).

Subgenus ADANA CLAVA Bartsch, 1950 (of *Crassispira*),

*Nautilus*, 63, 3, p. 87. Type (o.d.) *Adanaclava adana* Bartsch, 1950.

Plate 11, fig. 18

Shell small, 12-13 mm., strong, broadly bi-conical, and boldly sculptured with heavy variciform axials, overridden by numerous spiral cords. The protoconch in the type specimen is incomplete, but what remains of the last whorl is stated to be carinated. Aperture elongate-ovate, terminated in a short distinctly notched anterior canal. Outer lip thin edged but strengthened behind by a heavy varix, and with a weak stromboid notch below. Sinus subsutural, broad and moderately deep, with a slightly reflected edge. Colour bright reddish-brown. Range — Known only by the type species which is Recent from Manzanillo, West Mexico.

Although *Adanaclava* was described as a genus, it is scarcely worthy of even subgeneric distinction from other "generic" taxa of Bartsch (1950), i.e., *Dallspira* and *Striospira*. It is very doubtful if there is any morphological difference from *Crassispira* among these narrowly defined "genera", which probably represent groups of species rather than distinct taxa.

Subgenus ZONULISPIRA Bartsch, 1950 (of *Crassispira*),

*Nautilus*, 63 (3), p. 89. Type (o.d.) *Pleurotoma zonulata* Reeve, 1843.

Plate 11, fig. 19

Shell of medium size, 21-22 mm., solid, with a tall spire but a truncated anterior end, and strongly sculptured with distant spiral keels, the peripheral one bearing laterally spreading



nodes. Colour black, often strikingly banded with white just above the suture and just below the anal fasciole. Aperture narrowly pyriform terminated below in a short widely open and very shallowly notched anterior canal. Outer lip thin at its outer edge but thickened behind. Protoconch of  $1\frac{1}{2}$ -2 smooth whorls followed by  $1-1\frac{1}{2}$  whorls sculptured with axial riblets. Sinus deep U-shaped, on the lower part of the shoulder slope, considerably constricted at the entrance by a massive parietal callus pad. Operculum irregularly ovate with a terminal nucleus. Radula of marginals only with the two basal limbs fused to form a hollow tube. Range — Gulf of California to Ecuador and at the Galapagos. Again there is little to distinguish *Zonulispira* from the typical genus, except for the form of the marginal tooth of the radula.

CHARACTERISTIC SPECIES—

*reigeni* (Bartsch, 1950), *zonulata* (Reeve, 1843).

Subgenus BURCHIA Bartsch, 1944 (of *Crassispira*),

*Nautilus*, 57 (4), p. 115. Type (o.d.) *Pseudomelatomella semiinflata redondoensis* Burch, 1938.

Plate 11, fig. 20

Shell rather large and solid, 45 mm., narrowly claviform, with a tall rather flat-sided spire, and a long narrow body-whorl, which gradually tapers to a short widely open and rather deeply notched anterior canal, backed by a striated and weakly ridge-margined fasciole. Colour brown, under an almost black periorstracum. Sculpture of long protractively oblique narrowly rounded axials, which are obsolete over a narrow subsutural sulcus, but again appear as weak nodules on a moderate subsutural fold. Sinus rather narrow, U-shaped, moderately deep, restricted above by the subsutural fold. Operculum small, oval, with a terminal nucleus. Radula "Y-shaped marginals only," according to Bartsch's published description (1944, p. 116) but actual drawings of the radula in the United States National Museum, prepared for Bartsch (text fig. C74), show the marginal teeth to be very like those of *Crassispira* (*maura* and *rudis* Sowerby) in that the proximal basal extremity has been severed and now appears as a slender separate plate, superimposed upon the massive elongated narrowly pointed main element.

The form of both the shell and the radula indicates close relationship with *Crassispira*, the type species, *bottae* (Kiener), being remarkably similar, so similar in fact that subgeneric differentiation for *Burchia* is the most that can be envisaged.

The original author of *redondoensis* referred his species to *Pseudomelatomella*, which is again of similar facies, particularly in the weakly gemmate subsutural fold, but that genus has a very different radula, of muricid style, with a

well developed unicuspid central tooth. The subgenus differs from *Crassispira* typical, only in having a less prominent subsutural fold, which is weakly nodulose, a slightly shallower sinus, a ridge-margined anterior fasciole, and a narrower form with a more attenuated spire. Range — Recent, 25 fathoms off Redondo Beach, California and Gulf of Panama in 511 fathoms.

CHARACTERISTIC SPECIES—

*redondoensis* (Burch, 1938), *clionella* (Dall, 1908).

Genus CARINODRILLIA Dall, 1919,

*Proc. U.S. National Mus.* 56, no. 2288, p. 17. Type (o.d.) *Clathrodrillia* (*Carinodrillia*) *halis* Dall, 1919.

Plate 12, fig. 1

Shell of moderate size, 14-35 mm., fusiform, with a tall spire of rather sagged turreted whorls, and a short body-whorl, rather quickly contracted to a moderately long to rather short slightly flexed weakly notched anterior canal. Protoconch of two depressed subcarinate smooth whorls. Adult sculpture of axial folds, spiral cords and threads; in the peripheral area, one or more of the overriding heavier spirals fuse over the axials to form low keels. Aperture narrow, with a thin outer lip, interrupted above by a deep narrow U-shaped sinus, restricted above by a moderate parietal callosity, at the termination of a prominent smooth subsutural fold. Colour uniformly whitish to brownish. Radula, a pair of simple slender curved non-barbed marginals (*haliplexa*). Range — Recent, Lower California and Central America, 10-90 fathoms and Miocene of Florida, Dominican Republic, Jamaica, Trinidad, Panama and Costa Rica. The record for the Miocene of southern India requires confirmation.

CHARACTERISTIC SPECIES—

Recent — *adonis* Pilsbry & Lowe, 1932, *alcestis* Dall, 1919, *bicarinata* Shasky, 1961, *dichroa* Pilsbry & Lowe, 1932, *duplicata* (Sowerby, 1834), *haliplexa* and *halis* Dall, 1919 and subsp. *soror* Pilsbry & Lowe, 1932, *jaculum* Pilsbry & Lowe, 1932, *thestia* Dall, 1919. Miocene — CARIBBEAN and CENTRAL AMERICA; *bocatoroensis* (Olsson, 1922), *cymatoides* Gardner, 1937, *elocata* (Pilsbry & Johnson, 1917), and subsp. *meta* Woodring, 1928, *fusiformis* (Gabb, 1873), *papaya* (Olsson, 1922), *propefusiformis* (Mansfield, 1925), *winchesteriae* (Pilsbry, 1922). ? INDIA; *fermori* Dey, 1962.

Subgenus BUCHEMA Corea, 1934 (of *Carinodrillia*),

*Smithsonian Misc. Coll.* 91 (16), p. 1. Type (o.d.) *Carinodrillia* (*Buchema*) *tainoa* Corea, 1934.

Plate 12, figs. 2, 3

Shell rather small, 9-15 mm., solid, fusiform-biconic, with a tall tabulated spire and truncated body-whorl, terminated in a short widely open shallowly to moderately deeply notched anterior canal, backed in the type species by a moderate fasciole. Protoconch of  $2-2\frac{1}{2}$  whorls, rather narrow but with a smooth blunt tip, the

last half whorl developing arcuate protractive axial riblets. Adult sculpture of very strong rounded axial folds, obsolete over the shoulder sulcus, overridden by strong rather narrow spiral cords, which become thickened where they cross the axials. Suture submargined by a moderate cord which is waved by the underlying axials. Aperture rather narrow, with a thin outer lip, interrupted above by a deep narrow U-shaped sinus, constricted above by a heavy parietal entering callus pad; lower outer lip with a distinct stromboid notch. Colour of the type species brownish, the intercostal spaces darker than the ribs. Range — Recent, Puerto Rico Deep, 17-120 fathoms, and the Pliocene of Florida.

#### CHARACTERISTIC SPECIES—

Recent — *apitaa*, *liella*, *mamona*, *suimaca* and *tainoa* Corea, 1934. Pliocene-pylosia Fargo, 1953.

#### Genus INQUISITOR Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Pleurotoma sterrha* Watson, 1881. Syns. *Ptychobela* Thiele, 1925, Wiss. Ergebn. dtsh. Tief — see Exped. 17, 2, p.181. Type (o.d.) *Pleurotoma crenularis* Lamarck, 1816. *Pseudoinquisitor* Powell, 1942. Bull. 2, Auck. Inst. Mus. p. 96. Type (o.d.) *Pseudoinquisitor problematicus* Powell, 1942.

#### Plate 12, fig. 4-7

Hedley proposed *Inquisitor* as a repository for elongate-fusiform, tall-spined 'drillias' of comparatively light build, which in these respects differed from the West African true *Drillia*, which is characterised by broader, stumpy, more solid shells, often with a distinct false umbilicus. There is a distinct radula difference also, for that of *Drillia (umbilicata)* is prototypic, with a small unicuspid central tooth, comb-like lateral and lanceolate marginal teeth, whereas that of *Inquisitor (griffithii)* consists only of a pair of slender marginals, barbed at the tip (text figs. D104, 105).

Some diverse elements were covered in Hedley's original inclusions in his genus; the protoconch varied from paucispiral to multispiral, and one, *granobalteus*, proves to be a *Turricula*, others the turriculid genus *Vexitomina*.

Noting the presence in the New Zealand Oligocene of two species, almost alike in their adult shell features but with very different apices, the present author (1942, Bull. 2, Auck. Inst. Mus. pp. 93-95) employed *Inquisitor* for a series with a tall conical smooth protoconch of up to five whorls, and proposed *Pseudoinquisitor* for a series with a bluntly rounded protoconch of 2½ smooth whorls.

The type of *Inquisitor*, however, the Recent *sterrha*, has, as described by Watson, "a protoconch of about 2½ very small, conically tapered embryonic whorls, parted by a very fine suture, and rising to a minute rounded tip." Thus the apical differences between the respective types of *Inquisitor* and *Pseudoinquisitor* is not so marked as between the two New Zealand Oligo-

cene species, *Inquisitor awamoaensis* (Hutton, 1873) and *Pseudoinquisitor problematicus* Powell, 1942.

Species with the *Pseudoinquisitor* style of protoconch are well represented in New Zealand, from the Eocene (probably) to the Miocene, and in the Miocene-Pliocene of Victoria. Shuto (1965, Mem. Fac. Sci. Kyushu Univ. ser. D, Geol., 16, 2, pp. 168-173) recognised both *Inquisitor* and *Pseudoinquisitor* at the generic level, from the Pliocene and Pleistocene of Japan, but for one of the species, *pseudoprincipalis* (Yokoyama, 1920), he figured a protoconch of intermediate character between those of the type species of the two 'genera,' but with leanings towards *Pseudoinquisitor*.

In the light of the above, it is doubtful if *Pseudoinquisitor* can be retained, even as a subgenus, since the only apparent difference between the apices of *Inquisitor* and *Pseudoinquisitor* is a narrowly conical and pointed protoconch for the former and a depressed globose protoconch for the latter, and even these apparently slight distinctions are not always clear-cut.

Thiele's *Ptychobela*, based upon the Indo-S.E. Asian *crenularis* (Lamarck) is inseparable from *Inquisitor*, for both have the same style of narrowly conical protoconch, and the general facies is very similar. Quite a number of Indian Ocean and S.E. Asian species qualify for inclusion in *Inquisitor*, and in some of these, *sterrha* and *suturalis* in particular, there is a strongly developed subsutural cord, reminiscent of *Crassispira*.

Shell rather large, 20-65 mm., elongate-fusiform, with a tall spire of rounded to subshouldered whorls, and an ovate body-whorl, slowly contracted to a shallowly concave neck, and a short to moderately long, slightly twisted and distinctly notched anterior canal. Protoconch typically of about 2½ very small conically tapered smooth whorls, the tip minute and rounded; bluntly rounded, of 2½ smooth whorls (*Pseudoinquisitor*); roundly conical, of 3 smooth whorls (*pseudoprincipalis*); or narrowly conical of 4-5 smooth whorls (*awamoaensis*). Adult sculpture of strong vertical to slightly oblique axials, overridden by spiral cords and threads, the former often thickening where they cross the axials. Typically there is a strong subsutural fold composed of two linear spaced cords, followed by a rather deep and narrow spirally lirate shoulder sulcus. The axials stop suddenly, often as if planed off, at the lower edge of the shoulder sulcus. Aperture narrowly ovate-pyriform. Outer lip thin edged with a moderately deep U-shaped sinus, having a narrow to relatively broad approach, dependent upon the strength of the subsutural fold; there is a moderate to strong stromboid notch in the lower part of the outer lip. Inner lip with a smooth callus, produced into a



moderate pad above, where it meets the end of the subsutural fold. Colour of the type species rich chocolate with a wide peripheral white band. Other species buff to pale yellowish-brown, often lined or tessellated with reddish-brown.

For a description of the embryology of *griffithii* see Thorson (1940, Danish Scient. Invest. Iran, 2, pp. 207-210). Range — (Eocene to Recent); Recent-Indo-Pacific, from Persian Gulf to Japan and Australia down to New South Wales. Pleistocene — Japan. Pliocene — Japan and Victoria. Miocene — Burma, Japan and New Zealand. Oligocene and Eocene — New Zealand.

#### CHARACTERISTIC SPECIES—

Recent — *baynhami* (Smith, 1891), *crassicingulatus* (Schepman, 1913), *crenularis* (Lamarck, 1816), *fibratus* Hedley, 1922, *flavidulus* (Lamarck, 1822), *flindersianus* Hedley, 1922, *formidabilis* Hedley, 1922, *griffithii* (Gray, 1834), *jeffreysii* (Smith, 1875) (= *principalis* Pilsbry, 1895), *lassulus* Hedley, 1922, *multiliratus* (Smith, 1877), *rufolineata* (Schepman, 1913), *sterrhus* (Watson, 1881), *suturalis* (Gray, 1838), *tayloriana* (Reeve 1846), *varicosus* (Reeve, 1843). Pleistocene (Japan) — *totomiensis* subsp. *takamatsuensis* (Hayasaka, 1961). Pliocene (Japan) — *hyuganus* (Yokohama, 1928), *totomiensis* (Makiyama, 1931), *pseudoprincipalis* (Yokoyama, 1920), *ugariensis* (Makiyama, 1931), (Victoria) — *delicatulus*, *gippslandensis*, *scabriculus* and *trinervis* (Powell, 1944). Miocene (Burma) — *pinfoldi* (Vredenburg, 1921), (Japan) — *hyuganus yamajiensis* Shuto, 1961 (Victoria) — *oblongulus* (Harris, 1897), (New Zealand) — *flemingi* Vella, 1954, *hebes* (Marwick, 1931), *powelli* Dell, 1950, *waihoraensis* (Marwick, 1931). Oligocene (New Zealand) — *awamoaensis* (Hutton, 1873), *komiticus* Laws, 1939, *problematicus* (Powell, 1942). Eocene (New Zealand) —? *fraudator* (Finlay & Marwick, 1937).

#### Genus TOMOPLEURA Casey, 1904,

Trans. Acad. Sci. St. Louis 14, p. 138. Type (o.d.) *Pleurotoma nivea* Philippi, 1851. Syn. *Cryptomella* Finlay, 1924, Trans. N.Z. Inst. 55, p. 516. Type (o.d.) *Leucosyrinx transenna* Suter, 1917.

#### Plate 12, figs. 9, 10

Shell of moderate size, 15-33 mm., rather solid, claviform, with a tall rather straight-sided spire, and a short body-whorl, terminating in a very short spirally twisted anterior canal, deeply notched, and with a ridge-margined fasciole. Protoconch small, tall, narrowly conical, of 4-5 smooth whorls, the last half whorl or less, incipiently bicarinate and crossed by a few concavely arcuate axial threads. Adult sculpture of rather distant smooth narrow spiral cords or keels, the interstitial surface crowded with crisp axial growth threads. Outer lip thin, with a moderately deep U-shaped sinus, its apex on the lower part of the steeply descending shoulder slope; below, the lip is produced forward in a wide arc. Inner lip lightly glazed, the spirals showing through. No parietal callus pad, but in mature shells the lower part of the pillar is distinctly spirally ridged. Colour white to light pinkish-brown, the spiral keels paler. The operculum is not, as described and figured

by Hedley (1922, Rec. Austr. Mus. 13, pl. 42, f. 4) subovate, with a subterminal nucleus, but leaf-shaped with a terminal nucleus. Hedley probably mistook for the nucleus, the subterminal muscle scar, showing through from the other side. The radula (*pouloensis*, from the Persian Gulf; text fig. D95) consists of a pair of long curved slender marginals, the base weakly foliated and the tip suddenly produced to a needle-like point. Range — Recent, Indo-Pacific, Aden and Persian Gulf to Japan, Pleistocene and Pliocene of Japan, Pliocene of Australia and Paleocene to Miocene of New Zealand.

#### CHARACTERISTIC SPECIES—

Recent — *nivea* (Philippi, 1851), *pouloensis* (Jousseaume, 1883), *vertebrata* (Smith, 1875) (= *violacea* Hinds, 1843). Pleistocene (Japan) — *quantoana* (Yokoyama, 1920), *subdifficilis* subsp. *akabanensis* Hayasaka, 1961. Pliocene (Japan) — *subdifficilis* (Makiyama, 1927), (Australia) — *dilectoides* (Chapman & Gabriel, 1914), *ludbrookae* Powell, 1944. Miocene (New Zealand) — *clifdenica* and *wai- auensis* Powell, 1942, Oligocene (New Zealand) — *crassispinalis* (Marwick, 1929), *excavata* (Hutton, 1877), *finlayi* Powell, 1942, *transenna* (Suter, 1917). Paleocene (New Zealand) — *striata* (Marshall, 1917).

#### Subgenus MAORITOMELLA Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 113. Type (o.d.) *Pleurotoma albula* Hutton, 1873. Syn. *Narraweena* Laceron, 1954, Handb. Roy. Zool. Soc. N.S.W., p. 19. Type (o.d.) *Asthenotoma subtilinea* Hedley, 1922.

#### Plate 12, fig. 8

The following group of shells has all the essential characters of *Tomopleura*, except for the protoconch, which is blunt, smooth, and paucispiral, instead of being narrowly conical of 4-5 smooth whorls. The relationship between *Maoritomella* and *Tomopleura* is paralleled by *Lophiotoma* and *Lophioturris*, and similar pairs, in which the respective shells appear to be identical, except for the protoconch, which is multispiral in the one and paucispiral in the other. The relationship between these 'pairs' is not so far understood, but for the present such 'pairs' are admitted subgeneric status.

Mr W. F. Ponder has allowed me to refer to some notes he made upon the living animal of *albula*. The tentacles are rather long, with very little taper, the proximal edge ending in a slight forwardly projecting lug, and the eye is sited almost at the extremity of the tentacle, on the distal side. Operculum ovate, with a terminal nucleus.

Radula (text fig. D97) consisting of loose awl-shaped marginals, gradually tapered to a sharp point, and with a moderate knuckle-shaped base. (*albula*). In *Tomopleura* the teeth are much longer, very slender, decidedly curved, and the end is suddenly produced to a needle-like point.

Laceron's *Narraweena* does not differ significantly from *Maoritomella*. The protoconch is narrowly papillate of 2½ smooth whorls,



ending in a slight varix; that of *Maoritomella* is slightly more depressed and does not exceed two whorls; too slight a difference to warrant the segregation of *Narraweena*, even as a subgenus. Laseron included a Queensland and two New South Wales species in his genus (*cicatrifolia* Hedley, 1922, *carrota* Laseron, 1954 and *subtilinea* Hedley, 1922).

Specimens of Laseron's *Narraweena carrota* from 22-25 fathoms South Queensland, sent by Mr B. Beutel of Redcliff, have a leaf-shaped operculum with a terminal nucleus, and the radula is intermediate in character between that of *Maoritomella* and *Tomopleura*. The marginals are long, slender, gently curved and gradually tapered to a sharp point, but not a 'hypodermic' point, as in *Tomopleura pouloensis*.

Two specimens, of *Tomopleura vertebrata* (Smith, 1875), from False Bay, South Africa in 30 fathoms, which were dissected by Mr Ponder, proved to have the operculum absent, and no evidence of an opercular lobe either. The radula consists of a pair of short rather straight marginals with a simple expanded base, and a slight expansion a short distance down from a simple sharp point.

In describing the same species from South African material, Barnard (1958, Ann. S. African Mus. 44, pp. 112-113) found an operculum present, and a similar radula, except for the tips of the marginals which have a slight arrow-head form.

More work on the radulae and general anatomy of this group is essential before *Tomopleura*, *Maoritomella* and *Narraweena* can be satisfactorily evaluated.

#### CHARACTERISTIC SPECIES—

Recent (New Zealand) — *albula* (Hutton, 1873), *ischna* (Watson, 1881), *multiplex* (Webster, 1906), *orientalis* Dell, 1956, (Australia) — *carrota* Laseron, 1954, *cicatrifolia* (Hedley, 1922), *dilecta* (Hedley, 1903), *foliacea* and *thola* Laseron, 1954, *subtilinea* (Hedley, 1922). (Zanzibar) — *regina* (Thiele, 1925). Pleistocene (New Zealand) — *robusta* Powell, 1942, *studiosorum* (King, 1933), *subalbula* (Murdoch, 1931). Pliocene (New Zealand) — *pagodula* Powell, 1942, *torquatella* (Marwick, 1931), (Australia) — *nutans* Powell, 1944. Miocene (New Zealand) — *rupta* (Marwick, 1931), (Australia) — *balcombensis* Powell, 1944. Oligocene (New Zealand) — *annosa*, *pukeuriensis* and *sola* Powell, 1942, (Australia) — *equispiralis* Powell, 1944.

Range — Oligocene to Recent, New Zealand, and south-eastern Australia, 10-700 fathoms and Recent off Zanzibar, 463 metres.

#### Genus PHENATOMA Finlay, 1924,

Trans. N.Z. Inst. 55, p. 515. Type (o.d.) *Pleurotoma novaezelandiae* Reeve, 1843.

#### Plate 12, figs. 11, 12

Shell rather large, up to 33 mm., with a tall spire and a narrow body-whorl gradually tapered to a short slightly twisted deeply notched anterior canal, with a distinct ridge-margined fasciole. Protoconch small, narrow,

of 3½ smooth whorls, the tip flattened and planorbid. Adult sculpture of broad flattened spiral cords with linear interspaces, the spirals rendered nodulose by numerous axial grooves (in the type species). Whorl outlines lightly convex, but with a narrow sinus sulcus which defines a rather broad subsutural fold. Aperture narrowly ovate; outer lip thin with a deep narrow U-shaped supraproperipheral sinus, which is restricted above by the broad subsutural fold. Radula (text fig. D107) toxoglossate, a pair of long straight narrow marginals, slightly barbed on one side near the tip (Thiele, 1929). Operculum small, ovate, with a subterminal nucleus (*zealandica*; Suter, 1913). Range — New Zealand, Oligocene to Recent.

#### CHARACTERISTIC SPECIES—

Recent — *rosea* (Quoy & Gaimard, 1833) (non Sowerby, 1834) (= *novaezelandiae* (Reeve, 1843), *zealandica* (Smith, 1877) (= *cheesemani* Hutton, 1878); Pleistocene — *precursor* Powell, 1942, *rosea* (Quoy & Gaimard, 1833) (= *plicatella* Hutton, 1886); Pliocene — *decessor* Marwick, 1928; Oligocene — *lawsii* Powell, 1942, *perlata* (Suter, 1917).

#### Genus MICRODRILLIA Casey, 1903,

Proc. Acad. Nat. Sci. Phil. 55, p. 276. Type (s.d. Cossmann, 1906) *Pleurotoma cossmanni* Meyer, 1887 = *Pl. meyeri* Cossmann, 1906. Syn. *Acrobela* Thiele, 1925, Gast. Deutsch. Tiefsee — Exped. 17 (2), p. 238. Type (o.d.) *Bela* (*Acrobela*) *optima* Thiele, 1925.

#### Plate 12, figs. 13, 14

Shell small, 2.3-14 mm., claviform, with a tall spire, and a truncated anterior end. Protoconch narrowly conical of about five whorls, tip smooth, remainder axially costate. Sculpture of strong smooth spiral keels. Sinus area sunken between heavy subsutural and peripheral keels; the whole of the fasciole conspicuously sculptured with numerous concavely arcuate growth threads, marking successive positions of the moderately deep rounded sinus. Outer lip thin; anterior canal very short and weakly notched. The radula of *optima* (text fig. D106) consists of a pair of awl-shaped marginals with an expanded base. Range — Widely distributed both Recent and Tertiary from the Eocene upward; Recent — Indo-Pacific, East Africa to Japan, eastern Australia and the Caribbean to a depth of at least 390 fathoms; Miocene of Florida, Jamaica, Trinidad and Victoria, Australia; Oligocene, south-eastern United States and New Zealand; Eocene, south-eastern United States.

#### CHARACTERISTIC SPECIES—

Recent — INDO-PACIFIC; *circumvertens* (Melvill & Standen, 1901), *commentica* (Hedley, 1915), *difficilis* (Smith, 1879), *fastosa* (Hedley, 1907), *niponica* (Smith, 1879), *optima* (Thiele, 1925), *patricia* (Melvill, 1904), *sansibarica* (Thiele, 1925), *stephenensis* Laseron, 1954, *triporcata* (Smith, 1879); FLORIDA and CARIBBEAN; *comatotropicis* (Dall, 1881); *tiara* (Watson, 1881). Miocene — FLORIDA; *hebetica* Gardner, 1937; CARIBBEAN; *propetrina* Mansfield, 1925 *tersa* Woodring, 1928, *trina* Mansfield, 1922; AUSTRALIA; *steiroides* (Chapman & Crespin, 1928). Oligocene — SOUTHERN UNITED



STATES; *biplicatula* Casey, 1903, *infans* (Meyer, 1886), *vicksburgella* Casey, 1903; NEW ZEALAND; *pakaurangia* Powell, 1942. Eocene — SOUTHERN UNITED STATES; *citrona* Harris, 1937, *cossmanni* Meyer, 1887), *elongatula* Casey, 1903, *harrisi* (Aldrich, 1895) (= *aldrichiella* Casey, 1903), *infans* subsp. *bicincta* Harris, 1937, *minutissima* Casey, 1903, *ouachitae* Harris, 1937, *robustula*, *rostratula* and *solidula* Casey, 1903.

Genus SUAVODRILLIA Dall, 1918,

Proc. U.S. Nat. Mus. 54, no. 2238, p. 331. Type (o.d.) *Drillia kennicottii* Dall, 1871.

Plate 12, fig. 15

Shell moderately large, up to 37 mm., rather thin, claviform, with a tall pagodiform spire and a narrow body-whorl, quickly contracted to a moderately long decidedly twisted and rather deeply notched anterior canal. Protoconch small, turbinate of  $2\frac{1}{2}$  smooth whorls, the tip almost central and slightly inrolled. Spire-whorls dominated by a strong but narrowly rounded keel, which is situated at about a third whorl height. Body-whorl with a second keel, emergent at the lower suture, and seven more below to the anterior end, but becoming progressively weaker. There is also a broad but weak subsutural fold which bears two closely spaced fine threads at its lower margin. The shoulder slope is wide, flat and steep, which with the carina, impart the pagoda-like profile to the spire. Aperture ovate-pyriform. Outer lip thin edged, with a moderately deep U-shaped sinus, at the apex of a wide chevron-shaped entrance; the apex is on the lower part of the shoulder slope, immediately above the carina. The inner lip is a slightly excavated smooth callus without processes. Colour dull white to pale yellowish-brown, covered by a thin yellowish periostracum. Operculum leaf-shaped with a terminal nucleus. Radula (text figs. D98, 99) a pair of long and slender, slightly flexed, simple, pointed, non-barbed marginals, with a slightly thickened base. Range — Recent, Japan and Alaska, Pliocene and Miocene of Japan and Oligocene of Washington.

Grant and Gale (1931, Mem. San Diego Soc. Nat. Hist. 1, p. 509) considered *Suavodrillia* "not significantly different from *Aforia*." However, both the radula and the operculum show that relationship is probably with the Clavinae rather than with the Turriculinae.

CHARACTERISTIC SPECIES—

Recent — *declivis* (Martens, 1880), *kennicottii* (Dall, 1871), *sagamiana* Dall, 1925, *willetti* Dall, 1919. Pliocene — JAPAN, *declivis* (Martens, 1880), *bicarinata* Ozaki, 1958, *sakurai* Ozaki, 1958. Miocene — JAPAN, *yanagawaensis* Nomura & Zinbo, 1935. Oligocene — WASHINGTON, *hertleini* Durham, 1944.

Genus TYPHLOMANGELIA G. O. Sars, 1878,

Moll. Reg. Arct. Norv., p. 241. Type (monotypy) *Pleurotoma nivale* Loven, 1846.

Plate 12, figs. 16, 17

Shell rather small, 12-14 mm., with a tall spire of medially angulate whorls, and a broadly ovate body-whorl, deeply excavated to a relatively short, flexed, unnotched, spout-like anterior canal. Protoconch cylindrical of two whorls, the first depressed-globose and smooth, and the second taller, with lightly convex sides, developing low obscure axials over the last half whorl. Adult sculpture of numerous thread-like flexuous axials that thicken somewhat from the periphery to the lower suture; the whole surface crossed by dense spiral lirae. Aperture ovate-pyriform; outer lip thin edged, with a moderately deep U-shaped sinus, its apex on the lower half of the shoulder slope; inner lip excavated, lightly callused but without processes. Colour uniformly white to pale buff. Operculum narrowly leaf-shaped, with a terminal nucleus. Radula (Thiele, 1929, Handb. Syst. Weicht. 1, p. 365), marginals only, which are long and very pointed, gradually widening at the base. Range — Deep water basins of northern Europe to Spain, West Indies, 390 fathoms, New England, 1290 fathoms, South Africa, 1480-1660 fathoms, Kerguelen and Heard Islands and Antarctica. Also recorded from Japan in 8 fathoms and the Pleistocene of San Pedro, California, but these two are subject to check.

CHARACTERISTIC SPECIES—

Recent (North Atlantic) — *nivale* (Loven, 1846), *tanneri* Verrill & Smith, 1884, (Caribbean) — *linclia* (Watson, 1881), (Japan) — *pyrrha* (Watson, 1881), (South Africa) — *polythele* Barnard, 1963, (Subantarctic) — *cariosa* (Watson, 1886), *fluctuosa* (Watson, 1881), (Antarctic) — *principalis* Thiele, 1912. Pleistocene (California) — *renaudi* (Arnold, 1903).

Genus INODRILLIA Bartsch, 1943,

Mem. Soc. Cubana Hist. Nat. 17 (2), p. 101. Type (o.d.) *Pleurotoma (Drillia) nucleata* Dall, 1881. Syns. *Inodrillara* Bartsch, 1943, Type (o.d.) *Inodrillia (Inodrillara) miamia* Bartsch, 1943 and *Inodrillina* Bartsch, 1943, Type (o.d.) *Inodrillia (Inodrillina) ino* Bartsch, 1943, Mem. Soc. Cubana Hist. Nat. 17 (2), pp. 104, 118.

Plate 13, fig. 1

Shell small to moderate sized, 7-19 mm., claviform, very like *Splendrillia* in general facies but with a different protoconch and no subsutural margining cord or fold. Tall spired but with a truncated anterior end, terminated in a very short, broad, slightly oblique and shallowly notched canal. Protoconch of  $2\frac{1}{2}$ -3 whorls, subglobose dome-shaped, first whorl smooth, then developing axial riblets (last whorl crossed by spiral lirae in Bartsch's two subgenera, but not in the typical genus). Adult sculpture of simple bold rounded axial folds, stopped or only weakly developed over the shoulder slope, the lower limit of which is a weakly defined subangle, at about two thirds whorl height. Shell surface more or less shining but sculptured with weak to moderate spiral

striae or lirae. Outer lip varying from thin edged to weakly variced. Sinus rather deep, U-shaped and occupying most of the shoulder slope. Parietal callus with a clearly defined edge and thickened above in a pad of varying size, that sometimes greatly constricts the opening of the sinus, thus rendering it subtubular. There is a very weak insinuation of the lower outer lip, approximating to a stromboid notch. Colour white, without maculations.

Bartsch proposed two subgeneric divisions of his *Inodrillia* on the basis of comparatively slight differences in the protoconch. In *Inodrillia* typical, the protoconch is initially smooth but later develops axials. In both his *Inodrillara* and *Inodrillina* there is the same style of protoconch, but spirals cross the axials over the last whorl. It is considered that these small apical differences, unsupported by other differentiating characters, are insufficient to warrant the retention of Bartsch's two subgenera. Confirmation of this view is evidenced by the radulae of the three type species, *nucleata*, *miamia* and *ino*. All three are identical and of a type unlike other radulae known to me. The radula (text figs. E109-111) is of a pair of slender foliated marginals, shaped like an unfolding leaf. Range — Recent, North Carolina, Florida, Gulf of Mexico and the Caribbean, 35-390 fathoms.

#### CHARACTERISTIC SPECIES—

(*Inodrillia*); *cestrota* (Dall, 1889); *hesperia* Bartsch, 1943; *nucleata* (Dall, 1881) (= *amblyia* Watson, 1882); (*Inodrillara*); *acova* Bartsch, 1943; *aepynota* (Dall, 1889); *avira* Bartsch, 1943; *dalli* (Verrill & Smith, 1882); *gibba*, *hatterasensis*, *miamia*, *martha* and *vetula* Bartsch, 1943; (*Inodrillina*); *dido*, *hilda* and *ino* Bartsch, 1943.

Genus HAEDROPLEURA Bucquoy, Dautzenberg & Dollfus, 1883,

Moll. Mar. Roussillon 1, p. 85. Type (o.d.) *Pleurotoma septangularis* Montagu, 1803.

#### Plate 12, fig. 18

Shell rather small, 12-14 mm., solid, claviform, with a tall spire of almost straight outlines and an ovate body-whorl, slowly tapered to a short, undifferentiated, channelled but unnotched anterior canal. Protoconch papillate of 2½ smooth convex whorls, the tip broad and flattened. Adult sculpture of obliquely protractive strong broadly rounded axial ribs, which continue in alignment from whorl to whorl but fade out at about the middle of the base. Viewed from above the ribbing exhibits a septagonal pattern. Surface densely sculptured with spiral striae. Aperture narrowly ovate; outer lip thin edged but backed by a massive varix externally and with a smooth callus within; inner lip broadly smooth-callused; no apertural processes. Sinus a broad moderately deep subsutural excavation of the outer lip. Colour buff to light brownish. Radula (text fig. E112) — a pair of marginals only, which are long and narrow-shafted but

broaden towards the tip, after the style of the flukes of an anchor (Thiele, 1929, Handb. Syst. Weicht. 1, p. 362, fig. 443). Operculum leaf-shaped, with a terminal nucleus. Range — Recent, from England to the Mediterranean, West Africa and South Africa, the Pliocene of England and Italy and the Miocene of France and Italy.

#### CHARACTERISTIC SPECIES—

Recent — ? *dora* Thiele, 1925, *septangularis* (Montagu, 1803) (= *goreensis* Maltzan, 1883, = *heptagona* Scacchi, 1835 = *maltzani* Knudsen, 1952 = *plicatilis* Risso, 1826), subsp. *rigida* (Reeve, 1846) and *secalina* (Philippi, 1844). Miocene — Pliocene — *contii* (Bellardi, 1878), *proxima* (Peyrot, 1938). Many other Tertiary species have been attributed to this genus, but their respective claims require confirmation.

The genus is usually placed in the Mangeliinae, but the presence of an operculum, a well formed sinus, and general facies not unlike *Crassopleura*, indicates the Clavinae as a more likely location.

Genus SPLENDRILLIA Hedley, 1922,

Rec. Austr. Mus. 13 (6), p. 250. Type (o.d.) *Drillia woodsi* Beddome, 1883.

#### Plate 12, fig. 19

Shell of small to moderate size, 7-35 mm., tall-spined, but with a truncated base, and sculptured with prominent axials, stopped at the shoulder sulcus. Surface typically smooth and glossy but sometimes striate or lirate. There is a subsutural fold that is usually strongly developed. Protoconch paucispiral, bluntly rounded, smooth. Sinus on the shoulder slope, moderate to deep, rounded, sometimes subtubular. Outer lip thin at its edge, only slightly thickened behind, not variced, and with a slight stromboid notch. Anterior canal short, rather straight and broadly shallowly notched. There is a heavy entering callus pad, that sometimes renders the sinus subtubular. Operculum leaf-shaped, with a terminal nucleus. Radula (text figs. D78-80) prototypic, with a vestigial central tooth, wide comb-like laterals, and long slender simple pointed marginals (*aoteana*, *debilis* and *woodsi*).

The coloration is usually white or unicoloured, sometimes obscurely zoned but without a definite pattern. Recent, Indo-Pacific, Persian Gulf to Japan, south-eastern Australia and New Zealand. Pleistocene, New Zealand. Pliocene; New Zealand, Australia, Java and Japan. Miocene, New Zealand, Australia, Okinawa and Japan.

#### CHARACTERISTIC SPECIES—

Recent — AUSTRALIA; *bednalli* (Sowerby, 1896); *eburnea* (Hedley, 1922); *harpularia* (Desmoulins, 1842) (= *harpula* Kiener, 1839-40); *lygdina* (Hedley, 1922); *molleri* Lasseron, 1954; *nenia* (Hedley, 1903); *spadicina* (Hedley, 1922); *woodsi* (Beddome, 1883) (= *howitti* Pritchard & Gatliff, 1899) and subsp. *acostata* (Verco, 1909). NEW ZEALAND; *aoteana* Finlay, 1930 (= *laevis* Hutton,



1873); *benthicola* Dell, 1956; *debilis* Finlay, 1927 (= *parva* Suter, 1908); *jacula*, and *hermata* Dell, 1956; *kapuranga* Dell, 1953; *larochiei* Powell, 1940; *otagoensis* Powell, 1942; *roseacincta* and *runcinata* Dell, 1956. INDO-PACIFIC; *albicans* (Hinds, 1843); *cladonia* (Melvill & Standen, 1901); *dissecta* (Smith, 1888); *eva* (Thiele, 1925); *granatella* (Melvill & Standen, 1903); *intermaculata* (Smith, 1879); *laeta* (Hinds, 1843); *parciplicata* (Sowerby, 1915); *persica* (Smith, 1888); *praeclara* (Sowerby, 1915); *raricostata* (Smith, 1879); *resplendens* (Melvill, 1898); *solicitata* (Sowerby, 1913). Pleistocene—NEW ZEALAND; *aequistriata* (Hutton, 1886); *annectens*, *anomala*, *armata*, *cristata* and *edita* Powell, 1942. Pliocene — NEW ZEALAND; *afflicta* (Marwick, 1931); *clava* and *lincta* Powell, 1942; *koruahinensis* (Bartrum & Powell, 1928); *powelli* (King, 1933); *whangaimoana* Vella, 1954. AUSTRALIA: *adelaidae* Powell, 1944; *trucidata* (Ludbrook, 1941). JAPAN; *rinsuikawaensis* (Nomura, 1935); *lincta hagenoshitaensis* (Shuto, 1961); *osawanoensis pulchella* (Shuto, 1961); *praegracilis* (Makiyama, 1927). JAVA; *tjikeusikensis* (Oostingh, 1938). Miocene — NEW ZEALAND; *clifdenensis* Powell, 1942; *filiculosa* (Marwick, 1931). AUSTRALIA; *formosa* Powell, 1944; *trevori* (Tenison-Woods, 1879). OKINAWA; *incompta* and *nomurai* Mac Neil, 1960. JAPAN; *osawanoensis* (Tsuda, 1959).

Subgenus SYNTOMODRILLIA Woodring, 1928 (of *Splendrillia*),

Carnegie Inst. Washington Publ. no. 385, p. 160. Type (o.d.) *Drillia lissotropis* Dall, 1881.

Plate 12, fig. 20

Shell mostly small sized, 4.5-18 mm., closely resembling *Splendrillia*, but without a subsutural fold, and with axials that extend across the shoulder area from suture to suture. Protoconch slender of two smooth whorls. Range — Recent, Gulf of Mexico, Caribbean and tropical west America. Pliocene, Florida and South Australia. Miocene, Caribbean, Venezuela, Panama, Okinawa, Australia and New Zealand. Oligocene, Tasmania, Victoria and South Australia.

CHARACTERISTIC SPECIES—

Recent — GULF OF MEXICO; *lissotropis* (Dall, 1881); CARIBBEAN; *carolinae*, *tantula* and *woodringi* Bartsch, 1934; TROPICAL WEST AMERICA; *cybele* Pilsbry & Lowe, 1932. Pliocene — FLORIDA; *lissotropis* subsp. *scissurata* (Dall, 1890); SOUTH AUSTRALIA; *decemcostata* Ludbrook, 1941; *ludbrookae* Powell, 1944; Miocene — CARIBBEAN; *biconica* Weisbord, 1962; *espyra* and *iphis* Woodring, 1928; *inadrina* (Mansfield, 1925); PANAMA; *enneacyma* (Brown & Pilsbry, 1913); OKINAWA; *atsutaensis* Mac Neil, 1960; AUSTRALIA; *complexa*; *compta*; *obsoleta* and *venusta* Powell, 1944; NEW ZEALAND; *waiauensis* Powell, 1942. Oligocene — AUSTRALIA; *circinata* Powell, 1944; *sandleroides* (Tenison-Woods, 1877).

Subgenus HAUTURUA Powell, 1942 (of *Splendrillia*),

Bull. 2, Auck. Inst. Mus., p. 105. Type (o.d.) *Syntomodrillia (Hauturua) vivens* Powell, 1942.

Plate 12, fig. 21

Shell small, 8-15 mm., very similar to the subgenus *Syntomodrillia* in that the suture is not margined, but the axials, instead of extending from suture to suture, are absent from the shoulder slope and in most instances are re-

duced to a peripheral row of pointed tubercles. The surface is smooth, without spirals of any kind. Protoconch paucispiral of two smooth whorls. Range — Recent and Miocene of New Zealand and Pliocene of Victoria.

CHARACTERISTIC SPECIES—

Recent — NEW ZEALAND; *vivens* Powell, 1942. Pliocene — VICTORIA; *exuta* Powell, 1944. Miocene — NEW ZEALAND; *exiguus* and *laevella* (Marwick, 1931).

Genus AUSTRODRILLIA Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Pleurotoma angasi* Crosse, 1863.

Plate 13, fig. 2

Shell rather small, 7-13 mm., cylindrical, tall turreted — spired and with a truncated body-whorl, terminated in a very short and weakly notched anterior canal. Protoconch narrowly conical of two smooth whorls. Adult sculpture of long heavy axial ribs, stopped at the shoulder angle and crossed by fine spiral threads. Sinus wide and deep, U-shaped, on the shoulder slope. Aperture without a labial varix, the edge being simple, without a stromboid notch. There is a heavy parietal callus pad but no subsutural fold. The type species is buff coloured with a broad median zone of dark reddish-brown, which is only in the interstices of the axials. Range — Recent, New South Wales, Tasmania, Victoria and South Australia. Beets (1941, Verhand. Geol. Mijnb. Ned. en Kolon. Geol. Ser. 13, p. 126) described a *Drillia (Austrodrillia) durgae*, from the Miocene of Borneo, but it is unlikely that there is close relationship with the Recent Australian genus.

CHARACTERISTIC SPECIES—

*achatina* and *agrestis* (Verco, 1909); *angasi* (Crosse, 1863); *beraudiana* (Crosse, 1863) (= *taeniata* Tenison-Woods, 1879); *dimidiata* (Sowerby, 1896); *saxea* (Sowerby, 1896); *subplicata* (Verco, 1909).

Subgenus REGIDRILLIA Powell, 1942 (of *Austrodrillia*),

Bull. 2, Auck. Inst. Mus., p. 98. Type (o.d.) *Austrodrillia (Regidrillia) sola* Powell, 1942.

Plate 12, fig. 22

Shell rather small, 10-11 mm., but very solid, claviform, with a moderately tall spire and a truncated body-whorl, with a very short widely open, very shallow, notched anterior canal. Protoconch rather large, depressed dome-shaped, of 2½ smooth whorls, the last carinated, the carina commencing near the lower suture but becoming nearly central over the last half whorl. Adult sculpture of strong broadly rounded axial folds, commencing abruptly at the shoulder angle and extending below the lower suture to the upper part of the base, after which they become obsolete. Spiral sculpture of weak low rounded cords, commencing at the top of the axials, which they override, and continuing to the anterior

end. Axial and spiral sculpture absent from the broad slightly concave and steeply descending shoulder slope. Aperture rather narrow; outer lip thin but strengthened behind by a varix. Sinus U-shaped, moderately deep, occupying the lower half of the shoulder slope and constricted above by a very heavy entering parietal callus pad. Colour buff with a subperipheral or basal zone of light reddish-brown.

The subgenus differs from *Austrodrillia* typical in having a large depressed dome-shaped carinated protoconch, that of *Austrodrillia* is of two elevated smooth whorls, and in the massive development of the apertural callus pad. Range — Recent, New Zealand, from off the Three Kings Islands in 100 fathoms, the Great Barrier Island and Bay of Plenty.

#### CHARACTERISTIC SPECIES—

*sola* Powell, 1942; *secunda* Powell, 1965.

#### Genus PARACUNEUS Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W. p. 14. Type (o.d.) *Mangelia immaculata* Tenison-Woods, 1876.

##### Plate 13, fig. 4

Shell claviform, of moderate size, 12-18 mm., solid, with a tall spire and an elongated body-whorl, tapered to a very short, very weakly notched anterior canal. Protoconch dome-shaped of two smooth whorls. Adult sculpture slight, weak indistinct spiral threads and weak vertically compressed nodes on a median weak angulation. Aperture long and narrow. Outer lip thin, with a deep U-shaped sinus, occupying the lower two thirds of the shoulder slope, and a distinct stromboid notch below. Inner lip with a heavy entering parietal callus pad. Unicoloured, creamy-buff to light reddish-brown. Range — Recent, New South Wales, Victoria and Tasmania.

#### CHARACTERISTIC SPECIES—

*immaculatus* (Tenison-Woods, 1876) (= *gabrielii* Pritchard & Gatliff, 1899) and subsp. *peronianus* Laseron, 1954; *kemblensis* Laseron, 1954; *spadix* (Watson, 1886) and subsp. *tumulus* Laseron, 1954.

#### Genus CONTICOSTA Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W. p. 15. Type (o.d.) *Inquisitor petilinus* Hedley, 1922.

##### Plate 13, fig. 3

Shell rather small, 12.5 mm., claviform, with a tall subturreted spire and a rather long body-whorl, terminated in a short very shallowly notched anterior canal. Protoconch small of two smooth whorls. Adult sculpture of strong rounded axials, running from suture to suture and over the base to the anterior end, overridden by a few spiral cords. The shoulder area is almost indistinguishable and the axials cross it undiminished, and actually rise above the suture. The sinus is deep, U-shaped, and occupies most of the ill defined shoulder slope. The outer lip is thin and there is no trace of a stromboid notch. Inner lip with a thick

entering parietal callus pad. Colour buff, with two pale brownish zones, one subsutural and the other peripheral. Range — Known only by the type species from Jervis Bay, New South Wales.

#### Genus PULSARELLA Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W. p. 20. Type (o.d.) *Pleurotoma cognata* E. A. Smith, 1877.

##### Plate 13, fig. 6

Shell of moderate size, 21-24 mm., claviform, with a tall spire, but a short body-whorl, rather quickly contracted to a short straight unnotched anterior canal. Whorls numerous and short since each volution overlaps the previous one to such an extent that only a small portion of each whorl remains visible. The apex is worn in all available specimens, but the protoconch is indicated as probably paucispiral and relatively large. Adult sculpture of a few heavy rounded keel-like spiral cords and dense interstitial axial riblets. Range — Known only by the type species which is a Recent shell from southern Queensland and northern New South Wales.

It is relatively common as a beach shell but so far no living examples have been reported.

Since details of the apex and the aperture are not known with certainty the genus may yet prove to be close to, if not identical with, *Asthenotoma*.

#### Genus IREDALEA Oliver, 1915,

Trans N.Z. Inst. 47, p. 538. Type (o.d.) *Iredalea subtropicalis* Oliver, 1915. Syn. *Brephodrilgia* Pilsbry & Lowe, 1932, Proc. Acad. Nat. Sci. Phil. p. 47. Type (o.d.) *Brephodrilgia perfectus* Pilsbry & Lowe, 1932.

##### Plate 13, figs. 9-11

Shell small, 5-7.5 mm., like a miniature *Clavus*, narrowly ovate-fusiform to ovate-conical, with a moderate to tall spire, rather flat in outline, and a narrow body-whorl, truncated to a very short undifferentiated weakly notched anterior canal. Protoconch narrowly conical of  $3\frac{1}{2}$ -4 smooth whorls. Adult sculpture of long fold-like axials, very little diminished over the weakly defined shoulder sulcus. Surface smooth and shining or with weak spiral lirae. Aperture narrow; outer lip thin; sinus deep, U-shaped, on the shoulder slope, restricted above by a moderately heavy parietal callus pad. In *perfectus*, the type of *Brephodrilgia*, a heavy varix occurs at about a quarter whorl back from the outer lip, and although this feature has not been noted in the type of *Iredalea*, it does occur in *pusilla* (Garrett), another species of the typical genus. Colour of type species white, with a faint subperipheral brown zone; that of the type of *Brephodrilgia*, flesh-pink, with two narrow brownish spiral bands, the lower one broken up into a series of dots. There appear to be no significant differences between *Iredalea* and *Brephodrilgia*.



Range — Recent, Indo-Pacific, Madagascar, Queensland, New Hebrides, New Caledonia, Kermadec Islands, Cook Islands, Tuamotus and Hawaii (*Iredalea*), and tropical west America (*Brephodrilgia*).

CHARACTERISTIC SPECIES—

*acuminata* (Mighels, 1848), *macleayi* (Brazier, 1876), *pupoidea* (A. Adams, 1872). (= *victor* Sowerby, 1894), *pusilla* (Garrett, 1873), *subtropicalis* (Oliver, 1915 (*Iredalea*)), *ella* and *perfectus* (Pilsbry & Lowe, 1932 (*Brephodrilgia*)).

Genus CARINAPEX Dall, 1924,

Proc. Biol. Soc. Washington 37, p. 88. Type (o.d.) *Drillia minutissima* Garrett, 1873.

Plate 13, fig. 19

Shell minute, 3-3½ mm., but very solid, claviform, with a moderately tall spire and a truncated anterior end. Protoconch disproportionately large, broadly conical of about 4½ whorls, first 1½ whorls smooth with a small tip, followed by three whorls with a prominent low-set carina; regular concavely arcuate narrow axial ribs over the last 1½ whorls. Adult sculpture of heavy flattish topped spiral folds, two on the spire-whorls, several more on the base, the whole broken up into large squarish nodes by axial grooves. Aperture narrowly ovate, terminating in a very short unnotched anterior canal. Outer lip thickened but not variced, with a rather deep subsutural U-shaped sinus, which is rendered subtubular by a massive upper parietal rough callus. Colour uniformly reddish-brown. Operculum leaf-shaped, with a terminal nucleus. Radula (text fig. C75) of simple marginals only, which are flexuous, rather broad over the lower portion but tapered above to a sharp point. A narrow ridge runs near to, and parallel with, the inner edge of the tooth, for about two thirds its length. Range — Known only by the type species, which is common throughout the Hawaiian Islands and Midway Island.

Genus CERITOTURRIS Dall, 1924,

Proc. Biol. Soc. Washington 37, p. 88. Type (o.d.) *Ceritoturris bittium* Dall, 1924.

Plate 13, fig. 20

Shell very small, 6 mm., slender, claviform, with a very tall spire, almost twice the height of the aperture. Protoconch of 1½ smooth low conical whorls, followed by two whorls with a sharp median carina. Adult spire-whorls with rather distant axial folds overridden by 3-5 narrow spiral cords, the peripheral one and the one below it, rendering the axials subspinose. Base with more numerous spiral cords but with the axials obsolete. Aperture narrow, terminated in a short unnotched slightly recurved, spout-like anterior canal. Outer lip thickened but not variced. Sinus subsutural, deep, U-shaped, very constricted at its entrance by a massive upper parietal callus. Colour uniform light reddish-brown. Range — Known

only by the type species, which is from the Hawaiian Islands.

This small clavinid seems to be nearest allied to the other monotypic Hawaiian clavinid, *Carinapex*. It has a somewhat different protoconch, with the addition of regular axials and different adult sculpture, of spiral series of massive nodes. The style of aperture, however, is similar in both genera.

Genus AUSTRACLAVUS Powell, 1942.

Bull. 2, Auck. Inst. Mus., p. 119. Type (o.d.) *Drillia tenuispiralis* Marshall, 1918.

Plate 13, fig. 5

Shell small, to moderate sized, 6.5-16 mm., *Clavus*-like, with strong axial tubercles at the shoulder angle, but a relatively large, tall, narrowly conical protoconch of 4-5 smooth polished whorls, the tip minutely globular, flattened above, but not planorbid, ending abruptly in a sinusigerid varix, without a brephic stage. That of *Clavus* (*echinatus* and *vidua*) is small, smooth and paucispiral, dome-shaped, of less than two whorls, and passes into the adult axial sculpture without a varix or brephic stage. The outer lip has a deep rounded sinus occupying most of the shoulder slope, then produced forward in a claw-like manner, but again insinuated below in a distinct stromboid notch. The anterior canal is short and unnotched, its termination oblique to the axis. Parietal callus with a moderate to strong pad. Range — Oligocene and Miocene of New Zealand and Miocene of Victoria.

CHARACTERISTIC SPECIES—

Oligocene — NEW ZEALAND; *kaipara* (Laws, 1939); *marshalli* Powell, 1942; *nitens* (Marshall, 1918); *nodulatus* Laws, 1948; *tenuispiralis* (Marshall, 1918). Miocene — NEW ZEALAND. *awakinoensis*, *clifdenensis* and *finlayi* Powell, 1942; VICTORIA; *brevicaudalis*, *glaber*, *lygdinopsis* and *teres* Powell, 1944.

Genus AOTEADRILLIA Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 87. Type (o.d.) *Pleurotoma wanganuiensis* Hutton, 1873.

Plate 13, fig. 7

Shell rather small, 7.5-14mm., claviform, with a tall turreted spire and a moderately long, weakly and obliquely notched anterior canal. Protoconch depressed papillate of 2-3 glossy smooth whorls, the last with a blunt submedian carina. Sinus rather deep, U-shaped, restricted above by a heavy subsutural cord. No parietal callus pad. Lower outer lip with a slight indentation, scarcely a stromboid notch. Adult sculpture of axials, mainly peripheral, and numerous spiral cords that override the axials. Operculum leaf-shaped, with a terminal nucleus. Radula of marginals only, which are elongate-elliptical, sharply pointed above, and with a semidetached member, which protrudes below as an insertion plate (*rawitensis*; text fig. D 102). Range — Oligo-

cene to Recent, New Zealand, and lower Pliocene of Japan.

#### CHARACTERISTIC SPECIES—

Recent; NEW ZEALAND; *bulbacea* (Watson, 1881); *wanganuiensis* (Hutton, 1872) and subsp. *chordata* (Suter, 1908); *otagoensis* Powell, 1942; *rawitensis* (Hedley, 1922). Pleistocene — NEW ZEALAND; *alpha* (King, 1933); *apicarinata* (Marshall & Murdoch, 1923); *beta* (King, 1933); *bisecta* Powell, 1942; *wanganuiensis* (Hutton, 1873); *finlayi* Powell, 1942; *gamma* (King, 1933); *trifida* Powell, 1942. Pliocene — NEW ZEALAND; *consequens* (Laws, 1936); *thomsoni* Powell, 1942; *waihuaensis* Powell, 1942; JAPAN; *longiplicata* Shuto, 1961. Miocene — NEW ZEALAND; *asper* (Marwick, 1926); *exigua* and *ihungia* (Marwick, 1931). Oligocene — NEW ZEALAND; *callimorpha* (Suter, 1917).

#### Genus CLAVATOMA Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 106. Type (o.d.) *Clavatoma pulchra* Powell, 1942.

##### Plate 13, fig. 12

Shell of moderate size, 22-23 mm., claviform, with a tall turreted spire but a truncated body-whorl. Protoconch narrowly conical of  $3\frac{1}{2}$  smooth whorls. Adult sculpture of rounded knob-like axials, a strong series on a broadly rounded peripheral bulge, which occupies the lower half of the whorls, and three more subsidiary rows on the base. There is no subsutural fold, and the shoulder slope is wide, steeply descending and smooth. Sinus deep, U-shaped, occupying most of the shoulder slope. Outer lip thin, with a weak stromboid notch below. Aperture rather long and narrow, with a very short, widely open and broadly shallowly notched anterior canal. Parietal callus pad heavy. In sculpture the genus resembles *Crassispira*, but it differs in the absence of a subsutural fold and in the protoconch; that of *Crassispira* is paucispiral and blunt tipped, smooth at first, then developing axial riblets. Range — Known only by the type species from the Opoitian lower Pliocene of the Waiau and Wairoa subdivisions, North Island, New Zealand.

#### Genus MAUIDRILLIA Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 85. Type (o.d.) *Mangilia praecophinodes* Suter, 1917.

##### Plate 13, fig. 8

Shell rather small, 6.8-18mm., claviform, with a moderately tall turreted spire, and a truncated anterior end, terminated in a short canal, with a very shallow oblique notch. Protoconch globular of two smooth whorls. Sinus broad and rather shallow, occupying most of the shoulder area. Adult sculpture of weak to moderately strong axials, mainly of peripheral development, and an overall coverage of dense spiral cords or threads, which override the axials. Subsutural margining cord weak or absent and no parietal callus pad. Range — Oligocene to lower Pliocene of New Zealand, Eocene to Pliocene of South Australia, Vic-

toria and Tasmania, Miocene of Okinawa and Miocene and Oligocene of Japan.

#### CHARACTERISTIC SPECIES—

Eocene — SOUTH AUSTRALIA; *aldingensis* and *secta* Powell, 1944; Oligocene — VICTORIA; *torquayensis* and *trispinalis* Powell, 1944; TASMANIA; *pullulascens* (Tenison-Woods, 1877); NEW ZEALAND; *angustata* Powell, 1942; *browni* Marwick, 1943; *cinctuta* (Marwick, 1929); *clavicula* Powell, 1942; *costifer* (Suter, 1917); *fimbriata* Laws, 1947; *imparilirata* and *inaequalis* Powell, 1942; *praecophinodes* (Suter, 1917); *supralaevis* and *unilirata* Powell, 1942; JAPAN; *sphaerogemmata* Shuto & Ueda, 1963. Miocene — VICTORIA; *consutilis* (Tenison-Woods, 1880) (= *turrita* Chapple, 1941); *partinoda* and *serrulata* Powell, 1944; OKINAWA; *kachabaruensis* Mac Neil, 1960; JAPAN; *granulosa* Shuto, 1961. Pliocene — NEW ZEALAND; *acuta* (Marwick, 1928); VICTORIA; *intumescens* Powell, 1944. The Japanese and Okinawan fossils are admitted with some doubt.

#### Genus MAORICRASSUS Vella, 1954,

Trans. Roy. Soc. N.Z. 81 (4), p. 550. Type (o.d.) *Maoricrassus carinatus* Vella, 1954.

##### Plate 13, fig. 13

Shell small, 6.3 mm., broadly-fusiform-biconic, with medially strongly angulate whorls, boldly sculptured with strong rounded axials, crossed by prominent spiral cords, the heaviest one peripheral. The shoulder slope is wide, has a very weak subsutural fold but no other spiral sculpture. The axials override the shoulder slope but do not quite reach the suture. Protoconch of  $1\frac{1}{2}$  whorls, tip small, somewhat flattened and smooth, later portion with dense microscopic spiral threads, finally crossed by four thin concavely arcuate closely spaced axials. Sinus moderately deep, U-shaped, occupying most of the shoulder slope, no stromboid notch. The relationships of this genus are at present obscure since the apertural features are not completely known. It may be related to *Mauidrillia* or even *Inquisitor*. Range — Known only by the type species from the Tongaporutuan Miocene of Bell's Creek, South-east Wairarapa, New Zealand.

#### Genus TAHUDRILLIA Powell, 1942,

Bull. 2, Auck. Inst. Mus. p. 99. Type (o.d.) *Tahudrillia simplex* Powell, 1942.

##### Plate 13, fig. 18

Shell of light build, small, 9.6 mm., narrowly biconic, with a smooth surface, except for rather distant rounded nodules on the spire-whorls but becoming obsolete over the body-whorl. Protoconch dome-shaped of  $1\frac{1}{2}$  smooth whorls. Sinus broad, evenly arcuate, rather deep, occupying most of the shoulder slope, which is rather steep and relatively wide. Suture not margined. Aperture relatively long and narrow, ending in a short shallowly notched anterior canal. Outer lip thin, without a stromboid notch; inner lip with a very thin film of callus, without a parietal pad or tubercle. The genus shows some resemblance to *Splendrillia* in its smooth surface and rather simple nodu-



lose axial sculpture but lacks both a subsutural margining fold and a parietal callus pad. Range — Known only by the type species from the Kaiatan upper Eocene of McCullough's Bridge, South Canterbury, New Zealand.

Genus WAIRARAPA Vella, 1954,

Trans. Roy. Soc. N.Z. 81 (4), p. 549. Type (o.d.) *Wairarapa rebecca* Vella, 1954.

Plate 13, fig. 14

Shell small, 7.7 mm., but very solid, broadly claviform, with a moderately tall turreted spire but a rather short shallowly notched anterior canal. Protoconch depressed dome-shaped of  $1\frac{1}{2}$  smooth glossy whorls. Sinus moderately deep, U-shaped, its apex on the lower part of the shoulder slope. There is no stromboid notch at the base of the outer lip. Adult sculpture of heavy rounded axials which line up whorl after whorl, in protractively oblique lines, broken only over the sinus area of the lower part of the shoulder slope. There is a heavy subsutural fold which is nodulose in line with the axials; the surface, otherwise, is smooth. The genus appears to be nearest to *Splendrillia*, from which it differs in the form of sculpture, the axials rendering the subsutural fold nodulose and also in the lack of a stromboid notch. A probable second member of the genus is *Melatoma duplaris* Hedley, 1922, from the Gulf of Carpentaria, Queensland, which species has a similar nodulose subsutural fold. Range — The type species is from the Tongaporutuan Miocene of Bell's Creek, South-east Wairarapa, New Zealand.

Genus MITRELLATOMA Powell, 1942,

Bull. 2, Auck. Inst. Mus. p. 109. Type (o.d.) *Columbella angustata* Hutton, 1886.

Plate 13, fig. 15

Shell small, 10-10.5 mm., narrowly fusiform, *Mitrella*-like, with a tall spire of lightly convex, non-shouldered whorls, narrow body-whorl, and an anterior canal of moderate length, with a broad shallowly notched termination. Protoconch smooth of  $2\frac{1}{2}$  whorls, the tip off centre, the first whorl inflated and the second with steep straight sides. Adult sculpture of broad flattened linear-spaced spiral cords but no axials, apart from weak growth lines. Aperture narrowly lunate; outer lip thin edged. Sinus very shallow, only half as deep as wide, situated between the upper suture and the periphery. Range — The type species is from the Nukumaruan lower Pleistocene of Petane, Hawke's Bay, New Zealand. A second species, *Pleurotoma ligata* Defrance, 1826, from the Redonian Miocene of the Loire Basin, France, is claimed by Glibert (1954, Mem. No. 129, Inst. Roy. Sci. Nat. Belg. pl. 5, fig. 13), and judging from Glibert's figure, *ligata* certainly seems to belong to the New Zealand genus. Glibert made *Mitrellatoma* a subgenus of

*Asthenotoma*, a similar style of shell, but with a deeper, much more definite style of sinus.

There is a superficial resemblance between the type of *Mitrellatoma* and *Phenatoma precursor* Powell, 1942, also from the Nukumaruan of New Zealand, but that genus has a much deeper and narrower U-shaped sinus and a different protoconch, which is narrowly conical of  $3\frac{1}{2}$  smooth whorls, the tip flattened and planorbid.

Genus INTEGRADRILLIA Powell, 1942,

Bull. 2, Auckland Inst. Mus., p. 94. Type (o.d.) *Drillia integra* Tenison-Woods, 1880.

Plate 14, fig. 4

Shell rather small, 10-13 mm., narrowly fusiform, with a tall spire of rounded whorls, and a moderately long, straight, unnotched anterior canal. Protoconch bluntly conic of two smooth whorls, the initial coil oblique, almost lateral. Adult sculpture of broadly rounded, closely spaced, rather prominent axials, overridden by closely spaced spiral cords, reduced to threads over the otherwise scarcely differentiated shoulder slope. There is a narrow crenulated subsutural margining cord on the early whorls but this becomes obsolete over later whorls. Aperture long and narrow, considerably constricted towards the anterior canal. Outer lip thin at its outer edge but buttressed behind by a heavy rounded varix. Sinus deep, subtubular, occupying most of the shoulder slope, its entrance constricted above by a considerable thickening of the parietal callus. The genus differs from *Vixinquisitor* in the protoconch, which lacks the bulbous overhanging initial whorl of that genus, also it has a deeper subtubular sinus, and a longer anterior canal. Range — Known only by the type species which is from the Miocene of Victoria, Australia.

Genus VIXINQUISITOR Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 95. Type (o.d.) *Drillia vixumbilicata* Harris, 1897.

Plate 14, fig. 3

Shell of moderate size, 16-18 mm., claviform, with a tall spire and a rather narrow body-whorl, tapered to a short very shallowly notched anterior canal. Protoconch subcylindrical of  $2\frac{1}{2}$  smooth glossy whorls, the first bulbous, somewhat flattened at the asymmetric tip, wider and more convex than the almost straight-sided succeeding whorl. Adult sculpture weak, protractively oblique axials which become subobsolete over the body-whorl. There is a narrow but distinct subsutural margining cord, the rest of the surface crossed by closely spaced somewhat irregular spiral cords and threads which override the axials. There is a weak subangle at about two thirds whorl height. Aperture narrowly ovate; outer lip thin edged but variced behind. Sinus broadly



rounded, not very deep, rendered somewhat spout-like by a reflected edge and the encroachment of a thickened parietal callus pad. Below, the outer lip constricts suddenly towards the anterior canal but without a stromboid notch. The shell has something of the appearance of *Paracuneus* but in that genus the protoconch is narrowly conical without the bulging overhanging initial whorl. Range — Known only by the type species from the Balcambian Miocene of Victoria, Australia.

#### Genus BRACHYTOMA Swainson, 1840.

Treat. Malac., pp. 154, 314. Type (s.d. Herrmannsen, 1846) *Pleurotoma strombiformis* Sowerby, 1839 = *Pleurotoma stromboides* Sowerby, 1832, Genera of Shells, fig. 4.

#### Plate 13, fig. 21

I have not seen the type specimen of this genus, which is in the British Museum, but Sowerby's illustration shows a shell quite similar to both the Indonesian *Pleurotoma sumatrensis* Petit, 1852, and *Strombinoturris crockeri* Hertlein & Strong, 1951, from the Gulf of California.

In several museum collections I found specimens apparently identical with Petit's species, which all originated from the former London dealer Fulton, and were labelled "*Pleurotoma strombiformis* Sowerby, Gorée, West Africa". This name, however, neither occurs in any published list of West African mollusca, nor in Knudsen's recent revisions of West African turrids. Dr. Myra Keen wrote stating that she had examined the type of *stromboides* Sowerby, 1832 (= *strombiformis* Sowerby, 1839), and found pencilled on the tablet 'equals *sumatrensis* Petit'. All the specimens seen in museum collections labelled *strombiformis* are much closer to *sumatrensis* than they are to either Sowerby's figure of his species or to Hertlein & Strong's *Strombinoturris crockeri*. Reeve (1843, Conch Iconica 1, sp. 71) gives the type locality of *stromboides* as Bay of Panama in 7 fathoms, but nothing quite like Sowerby's figure has since been encountered in that region.

Sowerby's shell is apparently rather strongly axially costate but with subobsolete spiral sculpture, Hertlein & Strong's shell is weakly axially costate but has strong gemmate spirals, and Petit's shell has weak axials but distinct plain spirals.

The evidence suggests that there are two genera involved, *Brachytoma* for *stromboides* and *sumatrensis* and *Strombinoturris* for *crockeri*.

Shell of moderate size, 23-25mm., elongate-biconic, with a tall tabulated spire, and a long body-whorl, gradually tapered to a long anterior canal with a deeply notched and recurved termination. Whorls strongly angled medially, crossed by short bluntly rounded axials, which

do not cross the shoulder slope and do not extend below the lower suture. Spire a little less than the height of the aperture plus the canal. Aperture rather widely open and expanded above but narrowly contracted below. Outer lip thin edged but heavily variced behind, interrupted above by a deep U-shaped sinus, occupying most of the shoulder slope, and with a deep stromboid notch below. Inner lip smoothly callused but with a massive parietal pad above, which causes the suture to rise abruptly at its termination, almost to the level of the carina. Spiral sculpture apparently weak or subobsolete in *stromboides*; weak threads on the shoulder slope and moderately strong cords from the carina to the anterior end, in *sumatrensis*. Range — Bay of Panama ? (*stromboides*), Indonesia (*sumatrensis*).

The subfamily location of *Brachytoma* and *Strombinoturris* is problematic, for the shells look like large glyphostomids, without apertural processes, but on the other hand they may be better located in the Clavinae, for some species of *Inquisitor* have a similarly everted and expanded subvaricose outer lip.

#### Genus STROMBINOTURRIS Hertlein & Strong, 1951,

Zoologica (New York), 36(2), p. 84. Type (o.d.) *Strombinoturris crockeri* Hertlein & Strong, 1951.

#### Plate 13, fig. 22

Shell moderately large, 43 mm., elongate-fusiform, with a slender turreted spire and a long narrow body-whorl, gradually tapered to a relatively long flexed and recurved shallowly notched anterior canal. Protoconch of two smooth shining white whorls. Adult sculpture of broad axial folds, medially angulated and overridden by numerous crisp cords and threads, the former nodulose at points of intersection with the axials. Aperture narrow; outer lip thickened externally by a strong varix, and interrupted above by a deep rounded rim-margined sinus, which occupies most of the shoulder slope. Inner lip covered by a thin white callus and with a weak callus pad on the upper parietal wall, opposite to the sinus. Colour dull brownish. Range — Known only by the type species which is from the Gulf of California in 40-45 fathoms.

The systematics of this genus are in some confusion, for Hertlein & Strong considered their genus to belong 'provisionally' to the Columbelloidea, noting that "The combination of characters of the shell . . . are peculiar in that they are in part those of *Strombina* and in part those of *Clathrodrillia*".

However the well formed sinus, a feature lacking in *Strombina*, makes the genus an undoubted turrid. Further the species appears to be identical with the Panama shell claimed as *Pleurotoma stromboides* Sowerby, 1832, by Reeve (1843, Conch. Iconica 1, pl. 9, fig. 71),



but not that species. The original *stromboides* Sowerby, 1832 (Gen. Rec. & Foss. Shells, pl. 228, fig. 4) of which *Pleurotoma strombiformis* Sowerby, 1839 is an objective synonym (based upon the same type specimen as *stromboides*) is apparently a different shell, with the axials dominating the almost obsolete spiral sculpture. For *strombiformis* Sowerby, 1839, Swainson, (Treat. Malac. pp. 154 & 314) introduced *Brachytoma*, a name that has been misapplied to certain oriental clavinids, such as *jeffreysii* (Smith, 1875), *crenularis* (Lamarck, 1822) and *flavidula* (Lamarck, 1822), which would be better placed in *Inquisitor*.

#### Genus CYMATOSYRINX Dall, 1889,

Bull. Mus. Comp. Zool. 18, 29 (2), p. 95. Type (o.d.) *Pleurotoma lunata* Lea, 1843.

##### Plate 13, figs. 16, 17

Shell of moderate size, 10-45 mm., typically, solid, with a tall spire and a truncated body-whorl, terminated in a short, twisted, very deeply notched anterior canal. Protoconch papillate of two smooth whorls, the first rather bulbous, with a lateral tip, the next with a low-set peripheral carina. Adult sculpture, firstly a strong subsutural fold, which is nodulose where it overrides the axials, then a narrow deep shoulder sulcus, followed by strong very oblique broadly rounded axials, which extend below the lower suture and over the base to a deeply incised stromboid notch. Below this there is another sulcus, crossed by diminished axials, to a prominent ridge margined anterior fasciole. The whole surface is smooth and polished, without, or with a minimum of spiral sculpture. Aperture ovate, the outer lip widely flared but not variced. Sinus deep, U-shaped, on the shoulder sulcus and somewhat constricted at the entrance by a massive entering parietal callus pad. The radula of *hemphilli* (text fig. D88) is prototypic, with a minute vestigial central tooth, comb-like laterals, and long, slender, simple-pointed marginals, overlaid basally by a small narrow member.

The genus resembles *Splendrillia* in being sculptured with oblique axial ribs, and in having a comparatively smooth glossy surface, but that genus does not have a carinated protoconch, has a very slight stromboid notch, a much weaker anterior notch, and the anterior fasciole is not ridge-margined. Range — Eocene to Pliocene of the eastern United States, Pleistocene of the Galapagos Islands and Recent from off Bermuda, the Gulf of Mexico, and tropical western America. In addition to the species listed below the genus has been widely used for European, Javanese and Japanese Tertiary species, but no attempt is here made to evaluate these claims, since at present I do not have access to the material concerned.

#### CHARACTERISTIC SPECIES—

Recent; TROPICAL WEST AMERICA; *allyniana* Hertlein & Strong, 1951, *arbela* (Dall, 1919), *arenensis* and *asaedai* Hertlein & Strong, 1951, *ferminiana* and *hecuba* Dall, 1919, *hemphilli* (Stearns, 1871), *hespera* Dall, 1919 (= *elissa* Dall, 1919), *lilage*, *nielea* and *palmeri* Dall, 1919, *plicatella* (Dall, 1908), *pubica* and *quisqualis* (Hinds, 1843), *roseolus* (Hertlein & Strong, 1955) (= *rosea* Sowerby, 1834), *strohbeeni* Hertlein & Strong, 1951, *walteri* (M. Smith, 1946); BERMUDA; *bartschi* Haas, 1941; GULF OF MEXICO; *centinata* Dall, 1889. Pleistocene — GALAPAGOS; *zeteki* Dall & Ochsner, 1928. Pliocene — *lunatum* (Lea, 1843), *perpolita* (Dall, 1890). Miocene — *casula* Pilsbry & Harbison, 1933, *eburnea* (Conrad, 1862), *limatula* (Conrad, 1830), *louisae* (Maurry, 1910), *lunatum* (Lea, 1843) and subsp. *aepyptuberculata* and *porrecta* Mansfield, 1930, *polycyma* Pilsbry & Harbison, 1933, *propeaepynota* Mansfield, 1930, *pseudeburnea* (Heilprin, 1887), *tiara* Gardner, 1948, *vaughanensis* Mansfield, 1935, *whitfieldi* (Martin, 1904), *ziczac* Gardner, 1948. Oligocene — *glyphostoma* Dall, 1915, *silfa* (Dall, 1915. Eocene — *palmerae* Harris & Palmer, 1947.

#### Genus DOUGLASSIA Bartsch, 1934.

Smithsonian Misc. Coll. 91 (2), p. 5. Type (o.d.) *Dougllassia enae* Bartsch, 1934. Non *Dougllassia* Chambers, 1881, error for *Douglasia* Stainton, 1854 (*Lepidoptera*).

##### Plate 14, figs. 1, 2

Shell of medium size, 11-17 mm., claviform, or broadly fusiform, with a moderately tall spire and a truncated body-whorl, terminated in a very short widely open shallowly notched anterior canal. Protoconch narrowly conical, blunt tipped of 2½ smooth lightly convex whorls. Adult sculpture of prominent axial folds which are weak over the shoulder slope and on the base, but project cog-wise medially; otherwise the surface is smooth except for closely spaced spiral threads on the anterior fasciole and neck. Sinus deep, U-shaped, on the shoulder slope, somewhat constricted above by a rather heavy entering callus pad. Outer lip thin edged, with a very distinct stromboid notch. Colour yellowish with a pale brown sub-peripheral band. Range — Known only from the Puerto Rican Deep in 33-120 fathoms, and off northwest Florida in 14 fathoms.

The genus seems to be located between *Cymatosyrinx* and *Splendrillia*. It resembles the former in having a prominent stromboid notch but differs in its non-carinated protoconch. From *Splendrillia* it differs in the prominent stromboid notch, peripheral flanged axials and in the lack of a subsutural fold.

#### CHARACTERISTIC SPECIES—

*bealliana* Schwengel & McGinty, 1942, *enae* Bartsch, 1934.

#### Genus FENIMOREA Bartsch, 1934,

Smithsonian Misc. Coll. 91 (2), p. 3. Type (o.d.) *Fenimorea janetae* Bartsch, 1934.

##### Plate 14, figs. 5, 6

Shell of moderate to large size, 18-38 mm., solid, claviform, with a tall spire and a capacious body-whorl, truncated to a very short

deeply notched anterior canal. Protoconch blunt, of 1-2 smooth rounded whorls. Adult sculpture of numerous vertical fold-like axials that are retractively bent and reduced over the rather narrow shoulder sulcus. Except for the anal fasciole the surface, including the axials, is incised by numerous spiral striations. Sinus deep, U-shaped, rendered subtubular by a heavy entering parietal callus pad. Outer lip slightly flared, thin at the edge, crenulated by the spirals and thickened behind by the nearest axial. There is a small but very distinct stromboid notch low down on the outer lip. Inner lip callus free and sharp edged. Various maculated or broadly zoned in chestnut-brown on a pale ground. The genus resembles *Clathrodrillia*, especially in the tendency to form a humped rounded varix, about a third of a whorl back from the outer lip (*fucata*), but differs in having a much less flared outer lip, a shorter anterior canal and a fewer whorled protoconch. Range — Recent, North Carolina, Florida, Puerto Rico, St. Thomas and Haiti, 14-60 fathoms and Pliocene of Florida.

#### CHARACTERISTIC SPECIES—

Recent — *fucata* (Reeve, 1845) and subsp. *paria* (Reeve, 1846); *halidorema* Schwengel, 1940; *janetae* Bartsch, 1934; *moseri* (Dall, 1889) and subsp. *brunnescens* Rehder, 1943; *pagodula* (Dall, 1889). Pliocene — *fucata* subsp. *paria* (Reeve, 1846); *moseri* (Dall, 1889); *pagodula* (Dall, 1889).

#### Genus COMPSODRILLIA Woodring, 1928,

Carnegie Inst. Wash. publ. no. 385, p. 155. Type (o.d.) *Compsodrillia urceola* Woodring, 1928.

##### Plate 14, fig. 7

Shell mostly small, 7-13 mm., but up to 27.6 mm., elongate-fusiform, with a tall spire of rounded to subangulate whorls, and a rather inflated body-whorl, quickly contracted to a distinct neck and a rather short very shallowly notched anterior canal. Protoconch slender, cylindrical, of 2-2½ smooth whorls, followed by a few brephic axials. Adult sculpture of heavy rounded axials, overridden by spiral cords and numerous threads. The cords are thickened where they cross the axials. Sinus subsutural, moderately deep, U-shaped, the entrance somewhat constricted by a strong parietal callus pad. Outer lip thin edged but strengthened behind by a varix; stromboid notch obsolete. Range — Recent, Puerto Rico Deep, 180-300 fathoms, Pliocene of Florida and Miocene of North Carolina, Jamaica (type) and Trinidad.

#### CHARACTERISTIC SPECIES—

Recent — *disticha*, *nana* and *patersoni* Bartsch, 1934. Pliocene — *calesi*, *drewi* subsp. *pinellas* and *lipana* Fargo, 1953. Miocene — *chowanensis* Gardner, 1948, *catherina* Woodring, 1928, *dadrina* (Mansfield, 1925), *drewi* (Gardner, 1948), *senaria* and *urceola* Woodring, 1928.

The two Pliocene species from Japan and Okinawa, *nakamurai* Makiyama, 1931 and *torvita* Mac Neil, 1960, which were ascribed to

this genus by their respective authors, would be better placed in *Inquisitor*.

#### Genus LEPTADRILLIA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 159. Type (o.d.) *Turris (Surcula) parkeri* Gabb, 1873.

##### Plate 14, fig. 14

Shell small to moderate sized, 6.8-23 mm., narrowly fusiform, with a tall spire of lightly convex whorls, and a narrow body-whorl, produced into a relatively long and narrow feebly notched anterior canal. Protoconch moderately stout, consisting of two whorls, the latter part slightly bulging at the periphery. Adult sculpture of narrow axials that extend from suture to suture, but are bent and subdued on the anal siphonal fasciole. Spiral sculpture obsolete, except for a few threads on the anterior end. Sinus wide and shallow, near the suture; stromboid notch weak. Range — Miocene of the Dominican Republic and Jamaica, and Recent from off Puerto Rico, 17-195 fathoms.

#### CHARACTERISTIC SPECIES—

Miocene — *parkeri* (Gabb, 1873). Recent — *loria* and *splendida* Bartsch, 1934.

#### Genus GLOBIDRILLIA Woodring, 1928,

Carnegie Inst. Wash. publ. no. 385, p. 163. Type (o.d.) *Globidrillia ula* Woodring, 1928.

##### Plate 14, fig. 10

Shell very small, 5 mm., very slender, with a tall spire but a short body-whorl, deeply contracted to the neck, and with a short, wide, shallowly notched anterior canal. Protoconch rather stout, of about 1½ smooth whorls, the latter part bulging towards the lower suture. Adult sculpture of long narrow closely spaced protractive axials, suddenly reduced to obsolescence over the rather deep and narrow shoulder sulcus, but reappearing as strong sutural beads. Pillar sculptured with coarse spiral threads. Aperture short, relatively wide; outer lip thin edged, with a wide moderately deep U-shaped subsutural sinus, and a very shallow stromboid notch below. Inner lip thinly callused but with a free edge over the pillar region. The genus appears to be nearest allied to *Syntomodrillia*. Range — Known only by the type species from the Miocene of Bowden, Jamaica.

#### Genus AGLADRILLIA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 157. Type (o.d.) *Agldrillia callothyra* Woodring, 1928.

##### Plate 14, fig. 8

Shell of moderate size, 14-29.5 mm., fusiform, with a tall spire, of rounded whorls, and a body-whorl rapidly contracted to a relatively long anterior canal, with an oblique shallowly notched termination. Protoconch stout of two smooth whorls. Adult sculpture of strong



axials overridden by numerous spiral threads. Subsutural fold rather strong and rendered slightly nodulose by the axials. Sinus deep, U-shaped, on the shoulder slope, and rendered subtubular by a heavy parietal callus pad. Aperture long and narrowed anteriorly. Outer lip thin at the edge, dilated a little at the sinus, with a rather deep stromboid notch below, and strengthened behind by a variciform axial. Inner lip with a sharp free edge. Range — Miocene and Pliocene of Florida, Miocene of Jamaica and the Dominican Republic, and possibly the Miocene or Pliocene of Okinawa, and Recent from tropical West America.

The probable Recent member is the Panamic *Clathurella panamella* Dall, 1908, which was later referred to *Notocytharella*, with a query, by Keen (1958, p. 473). The radula of *panamella* (text fig. D82) shows that it is definitely clavinid, for it is prototypic, with a vestigial central tooth, comb-like laterals, and long narrow, basally bifid marginals.

#### CHARACTERISTIC SPECIES—

Miocene — FLORIDA; *agla* Gardner, 1947; *aulakoessa* Gardner, 1947; *dryados* (Maury, 1910); *empera* Gardner, 1937; *subvaricosa* Gardner, 1937); *uquala* Mansfield, 1935. JAMAICA; *callothyra* and *leptalea* Woodring, 1928; DOMINICAN REPUBLIC; *foveolata* (Pilsbry & Johnson, 1917). Pliocene — FLORIDA; *perrugata* (Dall, 1890). Miocene or Pliocene? — OKINAWA; *nakazaensis* Mac Neil, 1960. Recent — PANAMA; *panamella* (Dall, 1908).

Subgenus EUMETADRILLIA Woodring, 1928 (of *Agladrillia*),

Carnegie Inst. Washington Publ. no. 385, p. 159. Type (o.d.) *Agladrillia* (*Eumetadrillia*) *serra* Woodring, 1928.

#### Plate 14, fig. 9

Shell rather small, to moderate sized, 7-24 mm., very similar to *Agladrillia*, with strong rounded axials, but these stop at the lower edge of the shoulder slope, and both the spiral sculpture and the subsutural fold are obsolete. Apertural features as in *Agladrillia* but the anterior siphonal notch is deeper and the stromboid notch shallower. Range — Miocene of Florida, Jamaica and Panama; Recent from the Strait of Magellan.

#### CHARACTERISTIC SPECIES—

Miocene — FLORIDA; *centrodes* (Gardner, 1937); *dodona* Gardner, 1937; *newmani* (Dall, 1890); *rabdotacona* Gardner, 1937; *waltoniana* (Gardner, 1937); JAMAICA; *serra* Woodring, 1928. PANAMA; *isthmica* (Brown & Pilsbry, 1911); RECENT; *fuegiensis* (Smith, 1888).

Genus SEDILIA Fargo, 1953,

Monog. no. 8, Acad. Nat. Sci. Phil., p. 370. Type (o.d.) *Drillia sedilia* Dall, 1890.

#### Plate 14, fig. 11

Shell of moderate size, 11-20 mm., stoutly built, claviform, with a very tall more or less turreted spire but a truncated anterior end. Protoconch blunt of 2-2½ whorls, the first

whorl or less dome-shaped, smooth, after which stout axial riblets commence, crossed by spiral threads. Adult sculpture of long rounded axial folds, weak or absent over the shoulder sulcus, and overridden by numerous spiral cords. A weak to moderate smooth cord submargins the suture. Aperture ovate-quadrate, terminated in a very short, broadly and weakly notched anterior canal. Outer lip thin at its outer edge, with a moderately deep, broadly U-shaped sinus, occupying most of the shoulder slope, and without a stromboid notch below. Inner-lip callus with a free raised edge and thickened above into a moderate entering callus pad. Range — known only from the Pliocene of Florida.

#### CHARACTERISTIC SPECIES—

*hoplophorus* (Dall, 1892); *ochoidia*, *ondulum*, *sapa* and subsp. *sapala* and *transa* Fargo, 1953; *sedilia* (Dall, 1890); *schismatica* (Dall, 1892).

Genus OPHIODERMELLA Bartsch, 1944, Proc. Biol. Soc. Washington 57, p. 61. Type (o.d.) *Pleurotoma inermis* Hinds, 1843.

#### Plate 14, fig. 19

Shell rather large, 25-47 mm., narrowly-fusiform, with a tall spire of rather straight-sided whorls, and a long narrow body-whorl, gradually tapered to a relatively long, slightly flexed deeply notched anterior canal, with a distinct ridge-margined fasciole. Protoconch narrowly conical of about two loosely wound smooth whorls. Adult sculpture of flat-topped cords, separated by linear incised grooves, and crossed by numerous somewhat irregular weak axial folds, which form a chevroned pattern, tracing successive positions of the sinus. Sinus relatively weak, widely open but narrowly rounded at its apex, which is situated at the weak angulation. The suture is not margined, nor is there a shoulder sulcus, just a straight steeply descending slope. Aperture long and narrow; outer lip thin. Operculum irregularly ovate with a terminal nucleus. Colour buff to pale pinkish or greyish, with irregular narrow reddish-brown streaks, which follow the chevroned pattern of the axials. Range — Recent, California and Lower California, Pleistocene and Pliocene of California and Japan.

#### CHARACTERISTIC SPECIES—

Recent — *briseis* (Dall, 1919), *grippi* (Dall, 1919); *halcyonis* (Dall, 1908) (= *rhines* Dall, 1908), *incisa* (Carpenter, 1864) and subsp. *fancherae* (Dall, 1903), *montereyensis* Bartsch, 1944, *ophioderma* (Dall, 1908) (= *inermis* Hinds, 1843). Pleistocene — JAPAN; *sematensis* (Yokoyama, 1922). Pliocene — CALIFORNIA; *incisa* subsp. *quinquecincta* (Grant & Gale, 1931), *graciosa* (Arnold, 1907) and subsp. *mercedensis* (Martin, 1914); JAPAN; *bella* Ozaki 1958, *maekawaensis* Masuda & Suzuki, 1961, *miyatensis* (Yokoyama, 1920).

Genus HINDSICLAVA Hertlein & Strong, 1955,

Bull. Amer. Mus. Nat. Hist., 107, p. 227. Type (o.d.) *Clavatula militaris* Hinds, 1843.



## Plate 14, fig. 20

Shell moderately large, 16-48 mm., solid, elongate-fusiform, with tall turreted spire, narrow body-whorl and aperture, gradually tapered to a moderately long broadly notched anterior canal. The outer lip is not variced, just slightly thickened and crenulated by the spirals; there is also a very broad and shallow insinuation of the lower outer lip, the equivalent of a "stromboid notch".

Subsutural fold heavy, followed by a deep narrow shoulder sulcus, and a prominent bluntly rounded peripheral angle set at about three fourths whorl height. From the periphery to the anterior end, the whole shell is strongly sculptured with closely spaced slightly protractively oblique axials, which are crossed by spiral cords and threads; axials gemmate at all points of intersection with the spiral cords. Sinus deep and narrow and parallel sided, occupying most of the narrow shoulder sulcus. The subsutural fold terminates in a heavy callosity which is continuous with a parietal callus pad. Colour yellowish-brown to olive-brown, whitish on the inner lip and within the aperture. The genus is characterised by its elongated slender form with narrow slowly tapered, shallowly notched anterior canal, deep narrow sinus on the shoulder slope, heavily submargined suture and clathrate-gemmate sculpture. Range — Recent, Gulf of California to Colombia.

## CHARACTERISTIC SPECIES—

*andromeda* (Dall, 1919), *dotella* (Dall, 1908) and *militaris* (Hinds, 1843).

## Genus TURRIGEMMA Berry, 1958,

Leaflets in Malacology, Redlands, Calif. 1 (15), p. 88. Type (monotypy) *Turrigemma torquifer* Berry, 1958.

## Plate 14, fig. 21

Shell moderately large, 39.2 mm., fusiform, with a tall spire of angulate whorls, and a long body-whorl, gradually tapered to a moderately long, straight, weakly notched anterior canal. Protoconch cylindro-conic of about  $3\frac{1}{4}$  smooth whorls, the last subangulate. Adult sculpture firstly of a subsutural subtubercular margining thread, followed by a spirally striated shoulder slope, then from the shoulder angle downward there are numerous protractively oblique axials, which are rendered conspicuously nodose by closely spaced overriding spiral cords. Aperture narrow; outer lip thin-edged, with a deep U-shaped sinus, situated on the lower part of the shoulder slope, just above the peripheral angle. Above the sinus there is a conspicuous subsutural thickened spout-like projection. Colour ochraceous-tawny with the nodules conspicuously white. The systematic position of the genus is probably in the vicinity of *Hindsiclava*, from which it differs mainly, in the unique spout-like elaboration of the aper-

tural callus, and in the cylindro-conic protoconch. Range — Known only by the type species which is from off Isla de la Guarda, Baja California in 67 fathoms.

## Genus TRIPIA de Gregorio, 1890,

Ann. Géol. Paléont., Palermo, 7, p. 37. Type (Cossmann, 1896) *Pleurotoma (Tripia) anteatrila* de Gregorio, 1890.

## Plate 14, fig. 16

This genus is of uncertain status since the type species, presumably from the Claiborne Eocene of Alabama, but not actually so stated, has not since been recognised from the Claiborne localities or elsewhere.

In describing the genus, de Gregorio listed, along with *anteatripla*, the following European species — "Cette pleurotome ressemble à certaines espèces que M. Bellardi repra au gen. *Clavatula*; par examp. à la *Pl. circumfusa* Bell., *bicarinata* Bell., *complanata* Bell."

Cossmann, 1896, Ess. pal. comp. 2, p. 85) synonymised *Tripia* with *Crassispira*, but Glibert (1960, Inst. Roy. Sci. Nat. Belg. monog. 64, pp. 58-62) revived *Tripia* as a subgenus of *Crassispira* for twenty-nine Eocene species from the European Tertiary. However I cannot advise the use of *Tripia* unless its type species can be satisfactorily evaluated.

## Genus CRASSOPLEURA Monterosato, 1884,

Nomencl. Conch. Médit., p. 127. Type (monotypy) *Pleurotoma maravignae* Bivona, 1838. Syn. *Crossopleura* Monterosato, 1889, Journ. de Conch. 37, p. 117 (error for *Crassopleura*).

## Plate 14, fig. 12

Shell small, 12-13 mm., solid, biconically narrowly ovate, with a tall spire of lightly convex whorls and a truncated body-whorl ending in a very short and shallowly notched anterior canal. Protoconch tall, narrowly conical of four smooth whorls ending in a protractively arcuate sweep. Adult sculpture of closely spaced narrowly rounded but prominent long axials, which extend from suture to suture and over the entire base, the surface otherwise smooth. Aperture ovate; outer lip thin edged but variced behind. Sinus subsutural, broadly rounded and shallow, without a fasciole, but the axials are slightly concavely flexed over the sinus area. Inner lip smooth, with a very weak parietal callus pad. Colour light yellowish-brown, parietal callus and interior of the aperture lighter. Range — Recent. Mediterranean, Madeira and Canary Islands, Pliocene of Sicily and Italy, Miocene of France and the Vienna Basin, and possibly the Pleistocene of Japan and the Miocene of Okinawa.

A distinctive genus, easily distinguished by its long continuous narrowly rounded axials, devoid of spirals, and a tall conical smooth protoconch. The genus, perhaps, is nearest allied to *Clavus*.



## CHARACTERISTIC SPECIES—

Miocene to Recent, Europe — *maravignae* (Bivona, 1838) (= *costulatum* (Cantraine, 1835) = *elegans* (Scacchi, 1835) = *incisa* (Reeve, 1843) = *incrassata* (Dujardin, 1837). ? Miocene and Pleistocene — Okinawa and Japan, *brevis* (Yokoyama, 1922).

## Genus DRILLIOLA Cossmann, 1903,

Essais Pal. Comp. 5, p. 188. Type (o.d.) *Taranis emendata* Monterosato, 1872.

## Plate 14, fig. 13

Shell small, 9 mm., claviform, with a tall pagodiform spire, and an ovate body-whorl, tapered to a short rather deeply notched anterior canal. Protoconch, according to Cossmann (1903, Essais Pal. Comp. 5, p. 188, f. 14) of about  $2\frac{1}{2}$  carinate to bicarinate but otherwise smooth whorls. The figure, however, suggests an incomplete apex. Adult sculpture of rather prominent narrow spiral cords, 2-3 on the spire whorls, the first at or below the middle and the third emergent at the suture, over the last two whorls. Body-whorl with 12-14 cords. The shoulder slope is straight, steeply descending and wide. Sinus not clearly shown in illustrations but evidently broadly shallowly arcuate and occupying most of the shoulder slope. There is a surface sculpture of thread-like axials, most prominent over the shoulder slope, where they are crossed medially by two or three fine spiral threads. The colour is described as brown with the aperture white within. Range — Known only by the type species which is from the Mediterranean and Bay of Biscay in 100 to 300 metres.

There is a superficial resemblance to *Teretia* in the adult facies, but that genus is daphnellid, with a polygyrate diagonally cancellate protoconch, and a deep reversed L-shaped sinus.

## Genus BOREODRILLIA Sorgenfrei, 1958,

Geol. Surv. Denmark, ser. 2, no. 79, p. 271. Type (o.d.) *Boreodrillia toftlundensis* Sorgenfrei, 1958.

## Plate 14, fig. 15

Shell small, 3.65 mm., claviform. Protoconch bluntly rounded, papillate, of  $1\frac{1}{2}$  whorls, ending in a slight but distinct protractively arcuate varix; sculptured with closely spaced spiral rows of fine granules. Adult sculpture of long thin rather flexuous axials, extending from suture to suture and over most of the base; overridden by sharply raised narrow spiral cords. Sinus shallow, subsutural. Anterior canal short, apparently unnotched; no parietal callus pad.

The author compared his genus with the New Zealand Oligocene to Pliocene *Mauidrillia*, which it certainly resembles, except for the protoconch, which is smooth in the New Zealand genus. More exact comparison cannot be made at this stage since *Boreodrillia* is founded upon an immature shell. Range — Known only by the type species which is from the Miocene Arnum formation of Denmark.

## Genus MITRELOTURRIS Eames, 1957,

Brit. Mus. (Nat. Hist.), Geol. Bull. 3 (2), p. 51. Type (o.d.) *Asthenotoma* (*Endiatoma*) *casteri* Chavan, 1952.

## Plate 14, fig. 22

*Original description* — "Having the general form of *Mitrella*, elongate oval-conic to rather turriculate-conic. Protoconch unknown. About six spire whorls (only four preserved), which are flat-sided, their height a little more than half their width. Sutures linear slightly stepped. A narrow, flat, slightly raised juxtasutural band is limited abapically by a vague, narrow, spiral depression; whorls otherwise smooth. Last whorl about two-fifths of the height of the shell, narrowly oval, base narrowly and gently excavated, the neck of moderate length and swollen. Base and neck with spiral threads becoming increasingly stronger and more closely spaced abapically. Aperture narrow and parallel-sided, with a short, distinct siphonal canal notched at the end. Columella callus not extensive, smooth. Small adapical channel present. Outer lip (broken) evidently thin, not varicose, internally smooth, gently convex abapically, orthocline or slightly prosocline at the suture, with a broad, shallowly V-shaped sinus at a position corresponding to two-thirds of the height of the spire whorls. The two last whorls with a very vague angulation of the surface at the apex of the sinus." Estimated height of type species about 22 mm.

The author considered his genus to be allied to *Asthenotoma*, but if there is such relationship it is apparently not very close. Range — Known only by the type species from Bende Ameki, Eocene of Nigeria.

## Genus TEREBRITOMA Cossmann, 1894,

Annuaire géologique (for 1892), p. 773 (Neave, 1940, Nomencl. zool. 4, p. 427 quotes the date as "1894"). Type (monotypy) *Mangelia solitaria* Whitfield.

## Plate 14, figs. 17, 18

This genus is known to me only by Cossmann's entry in the Essais de Paléoconchologie Comparée (1896, vol. 2, pp. 110-111), where a very brief description and very sketchy line drawings were provided. From these illustrations the shell is shown to be a tall-spined clavinid or turriculid with very flat whorl outlines, spirally incised sculpture, and a very narrow aperture (possibly the result of distortion), terminated in a short, slightly flexed, weakly notched anterior canal. The sinus is distinct, moderately deep- V-shaped, but with a rounded apex, situated immediately below the suture. Range — Known, apparently only by the type species, which is from the Cretaceous of Mont Gazelle, Syria.

Cossmann considered *Terebritoma* to be related to *Trypanotoma* but that genus has a peripheral sinus, and is considered to belong to the Turrinae.

?Subgenus PSEUDODRILLIA Lukovic, 1924  
(of *Drillia*),

Eocene molluscan fauna of the Aral Sea and Lake Sschalkar region. Spomenck Srpska Akad. Belgrade 63, pp. 67-69. With n. spp. *longa*, *arabica* and *abnormalis* (Type?).

Range — Eocene, Kazak, southern Russia.

My only knowledge of this subgenus is the entry in the Zoological Record for 1925 (vol. 62, Mollusca, p. 68). The author's name, there given as 'Dukooizen', is apparently a Serbian rendering of Lukovic.

Subfamily CONORBIINAE Powell, 1942

The conorbid genera are here restricted to four, i.e. — *Conorbis*, *Cryptoconus*, *Benthofascis* and *Genota*.

These are the most conid-like of the turrid genera, and in the case of the Recent *Conorbis coromandelicus* (Smith), it is still a matter of conjecture whether that species is turrid or conid.

Cones have the habit of resorption of the internal whorls of the spire, and in the conorbids this habit applies partially, for a much reduced pillar remains, but the base of the spire whorls is dissolved. These observations are based upon sectioned examples of both the Eocene *Conorbis dormitor* and the Recent *Benthofascis biconica*.

The conorbids are ovate to elongate biconic and have a long narrow aperture. The sinus in *Conorbis*, *Cryptoconus* and *Benthofascis* resembles that of the daphnellids, descending straight and slightly retractively from the suture, after which it is confluent with a considerable arcuate projection of the outer lip. In *Genota* a heavy subsutural fold results in a more vertically confined sinus that is moderately deep U-shaped.

The radula in *Conorbis coromandelicus* (Thiele, 1929, Handb. Syst. Weicht., 1, p. 372, fig. 460) consists of loose marginals only, of conid-type, with a three-barbed tip, those of *Benthofascis* are similar but with a two-barbed tip, and in *Genota* the long slender awl-shaped marginals have a vestigial barb only.

There is a well developed long and narrowly ovate operculum with a terminal nucleus in *Benthofascis*, but none in either *Conorbis* or *Genota*.

The geological range of *Conorbis* is Cretaceous to Recent, of *Cryptoconus*, Eocene to Miocene, of *Genota*, Eocene to Recent, and of *Benthofascis*, Recent only.

Genus CONORBIS Swainson, 1840,

Treat. Malac. pp. 149, 312. Type (monotypy) *Conus dormitor* Solander, 1766.

Plate 15, figs. 1, 2

Shell of moderate size, 15-32 mm., coniform, with a broadly conical spire of straight outlines, and a long evenly tapered body-whorl,

ending in an undifferentiated, unnotched, spout-like anterior canal. Spire usually only half the height of the aperture. Protoconch small, broadly conical of three smooth whorls. Adult sculpture of spiral cords and dense axial interstitial growth threads. The shoulder sulcus is moderately wide, situated between a bicingulate subsutural fold and the uppermost of the spiral cords on the broadly rounded periphery. Aperture long, narrow and parallel sided. Outer lip thin, with a distinct subsutural sinus, which descends rather straight but retractively, to a rounded apex at the lower edge of the shoulder sulcus, after which the lip is produced forward in a great swinging arc. The inner lip is very thinly callused above, not obscuring the spiral cords, but below, the pillar as a raised, rounded, twisted free edge.

*Conorbis* appears to be very closely allied to *Conus*, for it has the same habit of resorption of the inner whorls of the spire, but not so completely as in *Conus*, for the pillar remains intact, although reduced in thickness, and only the walls disappear. The genus differs from *Cryptoconus*, in its more *Conus*-like shape, with a shorter more broadly conic spire, a broadly conical protoconch of 3 whorls, instead of a papillate one of 2½ whorls, a narrower parallel-sided aperture, and more prominent axial growth lines.

Thiele (1929, Handb. Syst. Weicht. 1, p. 372, fig. 459) cited *Conus coromandelicus* Smith, 1894, from Southern India, as a Recent member of *Conorbis*, figured the radula, which is decidedly *Conus*-like, but included the genus in the Turridae. The shell of *coromandelicus* is certainly very similar to that of *dormitor*, the Eocene type of *Conorbis*, and the sinus is identical in both. It is still a debatable point whether *Conorbis* should go in the Turridae or in the Conidae. If *coromandelicus* is really a descendant of the Cretaceous-Eocene *Conorbis* then its radula, which is toxoglossate, consisting of a pair of slender marginals with a several-barbed tip, indicates that this Recent species at least belongs in the Conidae. Some early *Conorbis* could well be the radicle from which the Recent Conidae have ascended. Range — Cretaceous of Tennessee, Eocene of Europe, S.E. United States and South Australia, Oligocene of Europe and India, Miocene of Java, and probably Recent of southern India.

CHARACTERISTIC SPECIES—

Cretaceous — *macnairiensis* Wade, 1917. Eocene (Europe) — *aequipartitus* Cossmann, 1889, *alatus* (Edwards, 1856), *amphiconus* (J. de C. Sowerby, 1850), *dormitor* (Solander, 1766), *marginata* (Lamarck, 1804), *subangulata* Deshayes, 1834, (Australia) — *atractoides* (Tate, 1890), (S.E. United States) — *conradi* Gregorio, 1890 (= *conoides* Conrad, 1835). Oligocene (Europe) — *procerus* Beyrich, 1853, (India) — *bhagothorensis* and *sindiensis* Vredenburg, 1925. Miocene (Java) — *umbgrovei* Martin, 1931.



Genus *CRYPTOCONUS* Koenen, 1867,  
*Palaeontographica*, 16, 3, p. 167. Type (s.d., Coss-  
 mann, 1889) *Pleurotoma filosa* Lamarck, 1804.

Plate 15, fig. 3

Shell rather small to moderately large, 13-46 mm., elongate-biconic, with the spire and the aperture of about equal height. Protoconch small, papillate, of about  $2\frac{1}{2}$  smooth whorls. Adult whorls lightly convex, but with a slight shoulder concavity; body-whorl long and narrow, gradually tapered to an almost undifferentiated short spout-like anterior canal. Sculpture of spiral cords or threads; the only axial sculpture being confined to dense very weak growth lines. Aperture long and narrow. Outer lip thin edged, with a distinct subsutural sinus which descends rather straight but retractively to a narrowly rounded apex, on the lower part of the shoulder slope, after which the lip swings forward arcuately. Inner lip a light spreading callus above, which gradually thickens below into a narrow smooth, rounded, slightly flexuous, narrow margin to the pillar, separated by a slight false umbilical chink. The Eocene Paris Basin *lineolatus* often preserves a colour pattern, which is of narrow spiral rows of reddish-brown dashes. Range — The Eocene of Europe, California, Barbados, India, Java and New Zealand; also the Miocene of Italy, East Indies and Java.

CHARACTERISTIC SPECIES—

Eocene (Europe) — *approximatus* (Deshayes, 1865), *baudoni* Cossmann, 1889, *clavicularis* (Lamarck, 1804), *denudata* (Deshayes, 1865), *elongatus* (Deshayes, 1834), *erectus* and *evulsus* (Deshayes, 1865), *filosus* and *glabratus* (Lamarck, 1804), *inaequistriatus* (Deshayes, 1865), *infragradatus* Cossmann, 1889, *interpositus* (Deshayes, 1865), *labiatus* (Deshayes, 1834), *lineolatus* (Lamarck, 1804), *pleurotomoides* Cossmann & Pissarro, 1901, *priscus* (Solander, 1766), *subdecussatus* (Deshayes, 1834), *subfilosus* (Orbigny, 1852), *sublaevigatus* (Orbigny, 1852), (Barbados) — *barbadensis* Trechman, 1925, (California) — *cooperi* Dickerson, 1916, *sandiegoensis* Hanna, 1927, (India) — *perliratus* Cossmann & Pissarro, 1909, (New Zealand) — sp. Powell, 1942, Miocene (Italy) — *degenis* and *exacutus* Bellardi, 1877, (East Indies), *rembangensis* Pannekoek, 1936.

Genus *BENTHOFASCIS* Iredale, 1936,

Rec. Aust. Mus. 19 (5), p. 319. Type (o.d.)  
*Bathytoma biconica* Hedley, 1903.

Plate 15, figs. 5, 6

Shell of small to moderately large size, up to 40 mm., elongate cylindro-biconic, solid, with a narrowly conical spire, of flat-sided whorls, about  $\frac{3}{4}$  the height of the aperture. Protoconch broad, low, dome-shaped, the tip flattened, smooth and inrolled, the next whorl spirally incised, after which the spiral interspaces develop into closely spaced cords, faintly crenulated subsuturally by protractively arcuate threads. Adult sculpture of numerous flat-topped spiral cords, separated by narrow interspaces, which are crossed by dense axial

growth lines. Aperture long, narrow and parallel sided, ending in a short, rather broad, and very shallowly notched anterior canal. Outer lip thin, with a deep sinus, which at first descends vertically and then inclines forward, confluent with a great arcuate sweep of the outer lip. Inner lip straight above, but strongly flexed and broadly callused towards the anterior end. Colour buff to whitish, broadly banded in reddish-brown; one band extending from the upper suture to just above the lower suture, the other occupying most of the mid base.

The genus is now divested of its problematic status through an investigation of the soft parts by Mr Winston Ponder. The radula (text fig. E125) consists of loose slender, straight, conid-like marginals, with a distinct barb, on each side, near to the sharply pointed tip. The operculum is long and narrow, ovate leaf-shaped, with a terminal nucleus, and in length, it is about five-eighths the height of the aperture.

Range — Recent, Australia, from South Queensland to Tasmania in 10-100 fathoms.

CHARACTERISTIC SPECIES—

*biconica* (Hedley, 1903) and *sarcinula* (Hedley, 1905).

The systematic position of *Benthofascis* is clearly with the Conorbiinae, as a near relative of *Cryptoconus*. The species *biconica* has another very definite conorbid feature in its habit of partial resorption of the internal whorls of the spire.

Genus *GENOTA* H. & A. Adams, 1853,

Gen. Rec. Moll. 1, p. 89. Type (s.d., Fischer, 1883)  
*Buccinum mitriformis* Wood, 1828. Syn. *Genotia*  
 Fischer, 1883, Man. Conchyl. p. 589 (an invalid  
 emendation).

Plate 15, fig. 4

Shell moderately large, 30-40 mm., solid, narrowly elongate-biconic, with a rather short turreted spire, and a very long narrow body-whorl, gradually tapered to a weakly differentiated short shallowly notched anterior canal, with a low inconspicuous fasciole. Protoconch small, erect, papillate, of two smooth shining whorls, the first planorbid and the second globose, developing very faint spirals towards its close. Adult whorls with a strong sutural fold, a relatively wide shoulder sulcus and a bluntly rounded submedian peripheral keel. The shoulder sulcus bears weak spiral threads but from the periphery downward and over the entire body-whorl to the anterior fasciole, the surface is cut into rather broad flattened spiral cords by linear grooves. The whole crossed by axial sculpture, which renders both the sutural fold and the peripheral keel somewhat nodulous, and cuts the remaining spiral cords into squarish gemmules. Aperture very long and narrow. Outer lip thin, descending rather straight, but interrupted above by a moderately deep U-



shaped sinus, with a rather widely divergent approach, its apex on the lower part of the shoulder sulcus. Inner lip long and straight without processes and lightly callused. Colour yellowish-brown to diffused rusty-brown. Radula (Thiele, 1929, Handb. Syst. Weicht. 1, p. 372, fig. 458), toxoglossate, a pair of lanceolate marginals, tapered to a very narrow point, minutely barbed at the tip, and with a knuckle-like base (text fig. E.126). Range — Recent, West Africa, Eocene to Pliocene of Europe and Miocene of Burma and Java.

The genus seems to have most in common with the Conorbiinae.

#### CHARACTERISTIC SPECIES—

Recent — *mitriformis* (Wood, 1828) (= *mitraefornis* Kiener, 1839-40 = *papalis* Reeve, 1843), *nicklesi* Knudsen, 1952, *vafra* Sykes, 1905. Pliocene — *bonnanii* Bellardi, 1877. Miocene — *birmanica* Vredenburg, 1921, *craverii* Bellardi, 1877, *garrowi* Vredenburg, 1921, *irravadicus* (Noetling, 1895), *jogjartensis* Martin, 1914, *mayeri* Bellardi, 1877, *ramosa* (Basterot, 1825), *singuensis* Vredenburg, 1921. Eocene — *conoides* (Solander, 1766), *ecostata* Cossmann, 1901, *liancurtensis* de Boury, 1899, *lyra* (Deshayes, 1834), *pyrgota* (Edwards, 1861), *staadti* Cossmann, 1913.

#### Subfamily MANGELIINAE (emended)

Fischer, 1887

This is a very large group of small fusiform, ovate or biconical shells, with a short or relatively short anterior canal, and a shallow to moderately deep, sometimes subtubular sinus, which is situated upon the shoulder slope. The aperture may be simple, with a thin outer lip, or it may be variced, either unarmed within, or bearing weak to strong denticles, and in some genera there are distinct entering pillar plications as well.

Typically, the radula consists of a pair of marginals, which are short and broad, rising obliquely from a straight base, or they may be of hilted-dagger form, usually with an up-curved spur at the base of the tooth proper.

The operculum is absent in the type genus and also in most of the genera, except for the Boreal group of *Propebela*, *Oenopota* and their relatives (*Lora* and *Bela* auct.), in which the operculum is fully developed, and in the New Zealand *Neoguraleus* and *Liracraea*, which have a fully formed operculum, but of vestigial size. In another New Zealand genus, *Antiguraleus*, which is superficially similar to *Neoguraleus*, the operculum is absent.

The earliest mangelinds seem to be *Buchozia* and *Amblyacrum* from the Eocene of the Paris Basin. The greatest development of the subfamily, however, is late Tertiary to Recent, the present range being world-wide.

#### Genus MANGELIA Risso, 1826,

Hist. Nat. Eur. Mérid. 4. p. 219. Type (s.d. Herrmannsen, 1852) *Mangelia striolata* Risso, 1826 = *Pleurotoma villiersii* Michaud, 1829 (of Kiener,

1839-40, Icon. Coq. Viv. pl. 27, fig. 1) = *Murex attenuatus* Montagu, 1803, Syns. *Villiersia* Monterosato, 1884, Nomencl. Gen. Spec. p. 128 (error for *Villiersia*; non d'Orbigny, 1837) = *Villiersia* (emended), Locard, 1886, Prodr. malac. Franc. Cat. Gen. Moll. France Moll. Mar. p. 118. *Villiersiella* Monterosato, 1890, Nat. Sicil. 9, p. 191, nom. nov. for *Villiersia* Monterosato, 1884. Type (monotypy) *Murex attenuatus* Montagu, 1803.

#### Plate 15, fig. 7

Shell small, 10-15 mm., narrowly fusiform, with a tall spire of evenly convex whorls, and a narrow body-whorl slowly tapered to a short unnotched anterior canal. Protoconch small, narrowly conical of 3 moderately convex whorls, the tip slightly inrolled and spirally striate, remaining two whorls smooth, followed by a whorl of rather distant brephic axials (Thorson, 1946, Medd. fra Komm. Danmarks Fiskeri-og Harund. Ser. Plankton 4, 1, p. 238, figs. 142 B,C.) (*attenuata*). Adult whorls strongly sculptured with rather distant long broadly rounded slightly flexuous axials, which extend from suture to suture and over most of the body-whorl and base. There is no defined shoulder slope or sinus fasciole, but the axials are thinned somewhat over that area and are shallowly concave, corresponding to a weak subsutural sinus. The whole surface is finely spirally striated. Outer lip either thin or variced, according to the stage of growth, whether the lip coincides with an axial rib or an interspace. Colour buff to light reddish-brown, sometimes with a darker basal zone. Operculum apparently absent. The radula (*attenuata*; text fig. E129) consist of marginals only, which are short, broad and leaf-shaped, with a thickened V-shaped base.

“Animal white with flaky specks. Its tentacula are closely set at their bases, very long for the genus, subulate, with the eyes on bulgings very low down and not far from their origin. The foot is lanceolate, truncated, and acutely angulated with auricles in front. The siphon is rather more attenuated than usual.” (*attenuata*) (Forbes & Hanley, 1851, Hist. Brit. Moll. 3, p. 490). Range — Recent, seas of northern Europe and the Mediterranean. The genus has been recorded from most temperate and tropical seas and from the Tertiary, back as far as the Eocene, but all these claims require careful investigation, since the name *Mangelia*, like *Bela*, has been subject to extensive conventional usage. At least one Indian Ocean species, however, *townsendi* Sowerby, 1895, seems to be definitely a *Mangelia*. It should be noted that the above is the correct spelling, not the emendation ‘*Mangilia*’.

#### Genus BELA Gray, 1847,

Ann. Mag. Nat. Hist. 20, p. 270. Type (s.d. Gray, 1847) *Murex nebula* Montagu, 1803. Syns. *Ishnula* (Clark ms.) Gray, 1847, Proc. Zool. Soc. p. 134 (nom. nud., but synonym of *Bela* inferred). *Smithia* Monterosato, 1884, Nomen. Gen. Spec. Conch.



Medit. p. 128. Type (monotypy) *Pleurotoma striolatum* Scacchi, 1836 (non Risso, 1826). *Smithiella* Monterosato, 1890, Natural. Sicil. 9. p. 186, nom. nov. for *Smithia* Monterosato, 1884 (non Milne-Edwards & Haime, 1851, non Maltzan, 1883). *Ginnania* Monterosato, 1884, Nom. Gen. Spec. Conch. Medit. p. 127. Type (tautonymy) *Mangilia ginnania* Risso, 1826 = *Murex nebula* Montagu, 1803.

Plate 15, fig. 10

Shell rather small, 15-24 mm., elongate-fusiform, with an attenuated spire,  $1\frac{1}{2}$  or more times the height of the aperture plus canal. The body-whorl is narrow, gradually contracted to a short, unnotched, spout-like anterior canal. Outer lip thin, without a varix. Sinus a weak broadly open chevron, its apex just above the weak shoulder angulation. Protoconch small, narrowly conical of about  $3\frac{1}{2}$  whorls, first two smooth, the remainder with spiral rows of tubercles. Adult sculpture of broadly rounded axial folds, which do not cross the shoulder slope and fade out at about the middle of the base. All post-embryonic whorls densely spirally striated. Colour varying from dull white to reddish-brown, the axials lighter coloured, Operculum apparently absent. Radula (*nebula*; text fig. E127) of marginals only, the individual teeth broad and flat, short and simple pointed, rising obliquely from a straight base.

"The animal is of a general white or yellowish-white hue, speckled with flaky yellowish dots. The tentacula are rather short, clavate at their tips, thickened by the connate eye pedicles for nearly two-thirds of their lengths, with the part on which the eyes are borne rather prominent and bulging." (Forbes & Hanley, 1851, Hist. Brit. Moll. 3, p. 479). Range — Recent, Norway and Britain to the Mediterranean and West Africa, Pleistocene of Iceland, England, Italy and Sicily, and Pliocene of northern Italy.

The genus name *Bela* has been not only the most persistently misapplied of all turrid names but also has been used as a "catch-all" for a wide variety of small turrids both Recent and Tertiary. The genus was long in use for a large group of Arctic shells now largely covered by *Oenopota* and *Propebela*.

CHARACTERISTIC SPECIES—

Recent — *nebula* (Montagu, 1803) (= *abbreviata* Jeffreys, 1867 = *chordula* Turton, 1819 = *discrepans* Brown, 1827 = *elongata* Jeffreys, 1867 = *formicaria* Forbes, 1844 = *fusiforme* Marshall, 1893 = *lactea* Jeffreys, 1867 = *laevigatum* Philippi, 1836 = *mediofasciata* Maltzan, 1883 = *pyramidatus* Brown, 1827 = *vittata* Norman, 1899), *ginnania* (Risso, 1826) (= *ginnanianum* auct.), *striolatum* (Scacchi, 1836) (non Risso, 1826), *taprurenensis* Pallary, 1904) and subsp. *recticosta* (Pallary, 1904). Pleistocene — *nebula* (Montagu, 1803) and subsp. *delicatula* Harmer, 1915. Pliocene — *nebula* (Montagu, 1803) and subsp. *odhneri* Schlesch, 1924.

Genus BUCHOZIA Bayan, 1873,

Etud. Coll. Ecole Mines, 2, p. 113, nom. nov. pro. *Etallonia* Deshayes, 1862, Descr. Anim. s. Vert. Bassin Paris, 2, p. 605. Type (s.d. Cossmann, 1896)

*Auricula citharella* Lamarck = *Fusus citharellus* Lamarck, 1803 (non *Cancellaria citharella* Lamarck, 1822) (This invalidates Dall's 1918 designation of *Etallonia prisca* Deshayes, 1862) (non *Etallonia* Oppel, 1861).

Plate 15, fig. 8

Shell small, ovate-fusiform, with a broadly conical spire of subglobose whorls, of equal height to the aperture plus the short anterior canal. Aperture ovate-pyriform. Outer lip rather thin, without a varix or apertural processes. Sculpture of bold, somewhat flexuous, rounded axials, and numerous rather strong spiral threads, which weakly override the axials. Sinus subsutural, rather broad and shallow. The genus somewhat resembles *Mangelia*, from which it differs mainly in its more broadly ovate outline. Range — The type species is from the Lutetian Eocene of Grignon, France. Deshayes' *Paleocene prisca* does not appear to belong to this genus, and even may not be a turrid.

Genus ENATOMA Roverto, 1899,

Atti Soc. Ligustica 10, p. 103, nom. nov. pro *Atoma* Bellardi, 1875, Bull. Soc. malac. Ital. 1, p. 24 (non Latreille, 1817). Type (monotypy) *Raphitoma hypothetica* Bellardi, 1847.

Plate 15, fig. 9

Shell small, 8-12 mm., solid, claviform, with a tall spire of lightly convex whorls, but a capacious body-whorl, broadly rounded, but quickly contracted to a short, straight, spout-like, channelled but unnotched anterior canal. Protoconch small, dome-shaped, of two whorls, the first bluntly rounded and smooth, the second apparently developing axial costae (worn example from the Tortonian Miocene of Italy). Adult sculpture of strong rounded axials, extending from suture to suture and over the entire base, the whole overridden by spiral threads. Aperture ovate; outer lip thin edged but thickened behind, in the adult, by a massive varix. Sinus subobsolete to obsolete, a very weak insinuation on the lower shoulder slope at most. Range — The type species is from the Helvetian Miocene of Turin, Italy; also recorded from the Aquitanian, Helvetian and Tortonian Miocene of France.

The genus is apparently related to *Mangelia* but is easily distinguished by its tall spire combined with an inflated body-whorl, massive labial varix and subobsolete sinus.

CHARACTERISTIC SPECIES—

*costata* and *gallica* (Peyrot, 1932), *hypothetica* (Bellardi, 1847), *inopinatus* (Peyrot, 1938).

Genus AMBLYACRUM Cossmann, 1899,

Ann. Soc. malac. Belg. 24, p. 291. Type (o.d.) *Pleurotoma rugosa* Deshayes, 1834.

Plate 15, fig. 11

Shell of small to moderate size, 5.5-25mm., fusiform-biconic, with a moderately tall spire of rounded whorls and an ovate subangulate

body-whorl, gradually tapered to a short unnotched anterior canal. Protoconch small, broadly conical of  $1\frac{1}{2}$  smooth whorls. Adult sculpture of numerous fold-like axials, extending from suture to suture but fading out over the base, overridden by numerous narrow spiral cords and threads. Aperture rather narrow, subparallel sided, and without denticles or plicae. Outer lip slightly variced but thin edged and incurved. Sinus subsutural, rounded and moderately deep. Range — Eocene of Paris Basin and Hampshire, England, Oligocene of North Germany.

The genus appears to be related to *Mangelia*, possibly a forerunner of it, differing mainly in its paucispiral protoconch and deeper, more definite sinus.

#### CHARACTERISTIC SPECIES—

(from Glibert, 1960, Inst. Roy. Sci. Nat. Belg., Mem. ser. 2, 64, pp. 78, 79) — Eocene — *baudoni* (Deshayes, 1865), *bernayi* and *boutillieri* Cossmann, 1889, *campbonense* Vasseur, 1881, *capellinii* (Deshayes, 1865), *costellatum* (Lamarck, 1804), *edwardsi* Glibert, 1960, *leptocolpa* Cossmann, 1889, *perplexum* (Deshayes, 1865), *rugosum* (Deshayes, 1834), *striolare* (Deshayes, 1865). Oligocene *holzapfeli* (Koenen, 1891) and *roemeri* (Philippi, 1843).

#### Genus AGATHOTOMA Cossmann, 1899,

Rev. crit. Paléozool. 3, 1, p. 45, nom. nov. pro *Ditoma* Bellardi 1877 (non Illinger, 1807), Mem. R. Accad. Sci. Torino, 2, 29, p. 295. Type (monotypy) *Mangelia angusta* (Jan) Bellardi, 1848.

#### Plate 15, fig. 15

Shell small to moderate sized, 4.5-15 mm., ovate-fusiform, with rounded whorls and a long ovate body-whorl, gradually contracted to a very short anterior canal. Protoconch evidently smooth and paucispiral. Adult sculpture of strong slightly oblique rounded axials, continuous from suture to suture, usually in line whorl to whorl, and continuous over the whole of the body-whorl and base. Subsidiary sculpture of numerous spiral threads, usually interrupted by the axials. Outer-lip variced, excavated above by a deep U-shaped subsutural sinus. Range — (typically) Miocene and Pliocene of Europe, the type species from the Plaisancian Pliocene of Italy. Also considered to belong to the Recent fauna of western America from California to Panama. Radula (*penelope* Dall, 1919; text fig. E130).

The genus resembles *Mangelia* but has a heavy labial varix, a much deeper anal sinus, and a shorter anterior canal.

#### CHARACTERISTIC SPECIES—

(European Pliocene — Miocene) — *angusta* (Jan) Bellardi, 1848, *brandenburgi* Boettger, 1902, *pherosae* Glibert, 1960. (Western America, Recent) — *aethra* and *electra* (Dall, 1919), *finitima* (Pilsbry & Lowe, 1932), *fusconotata* (Carpenter, 1864), *hilaira* and *melita* (Dall, 1919), *neglecta* (C. B. Adams, 1852), *penelope*, *phryne* and *quadriseriata* (Dall, 1919).

Genus BENTHOMANGELIA Thiele, 1925, Wiss. Ergebn. dtsch. Tief — See Exped. 17 (2), pp.

207, 224. Type (o.d.) *Surcula trophonoidea* Schepman, 1913.

#### Plate 15, fig. 14

Shell rather small, 16 mm., thin, fusiform, with a tall spire of medially angulate whorls, and a long body-whorl, slowly tapered to a moderately long slightly flexed unnotched anterior canal. Protoconch unknown. Adult sculpture of narrowly crested oblique axials, stopped at a weakly concave shoulder slope, and fading out on the base; tops of the axials as slightly pointed tubercles at the shoulder angulation. From the angulation downward the surface is crossed by flat-topped spirals separated by linear grooves. Aperture long and narrow. Outer lip thin, with a shallow sinus on the shoulder slope. Interior of aperture smooth. Colour white. Radula, figured by Thiele (1929, Handb. Syst. Weicht. 1, p. 367, fig. 453) is very like that of *Bela nebula* (Montagu); that is, marginals only, the individual teeth being broad, short and simple pointed, rising obliquely from a straight base (text fig E128). Range — Known only by the type species which is from the Flores Sea in 794 metres, and the Ceram Sea in 835 metres.

From *Bela* the genus is characterised mainly by a longer canal, but until the nuclear whorls are known a more critical comparison cannot be made.

#### Genus MANGILIELLA Bucquoy, Dautzenberg & Dollfus, 1883,

Moll. Mar. Roussillon, 1, 85, p. 108. Type (o.d.) *Pleurotoma multilineolata* Deshayes, 1833.

#### Plate 15, fig. 20

Shell small, 5-7 mm., narrowly ovate-fusiform, rather thin, with a tall spire of rounded whorls, very slightly round-shouldered, almost at the upper suture. Protoconch erect, peg-like, of two smooth whorls. Adult sculpture of numerous prominently raised but narrowly rounded flexuous axials, which commence strongly, rising above the suture; these alternate with the next whorl-series, causing the suture to be strongly undulating. The axials continue strongly over most of the base; surface otherwise smooth. Aperture long and narrow, terminating in a short, channelled but unnotched anterior canal. Outer lip strengthened by a smooth rounded varix which bears a small denticle on the inside, at the lower extremity of the sinus, this being a shallow subsutural excavation. Inner lip narrowly callused, with a defined edge but no apertural processes. Colour light brownish, either obscurely spirally lined in reddish-brown, or with three reddish-brown zones, one sutural, one peripheral, which is half emergent at the lower suture on the spire-whorls, and the third on the neck. Range — The type species is a Recent Mediterranean shell. The following species from the Pliocene of Italy, the Miocene



of France and the mid-Eocene of England and France, have been credited to this genus, but I have not had opportunity to examine relevant material.

Pliocene — *marcellinae* (Hornung, 1920), Miocene — *burdigalica* (Peyrot, 1932), *lepidus* (Peyrot, 1938), *salinensis* (Degrange — Touzin, 1894). Eocene — *plicata* (Lamarck, 1804), *semicostulata* (Deshayes, 1865).

The genus resembles *Lyromangelia* in its apertural details but the style of sculpture is quite different. In *Lyromangelia* the axials are few and strong, and are in line from whorl to whorl; in *Mangiliella* the axials are numerous, rise high above the suture, and alternate from whorl to whorl, causing the suture to be strongly undulating. These differences, however, probably reflect no more than subgeneric distinction between them.

Subgenus LYROMANGELIA Monterosato, 1917 (of *Mangiliella*),

Boll. Soc. zool. Ital. 3, 4, p. 25. Type (monotypy) *Pleurotoma taeniata* Deshayes, 1833.

Plate 15, fig. 13

Shell small, 7-9 mm., solid, ovate-biconic, with the spire slightly taller than the aperture. Protoconch smooth, of  $1\frac{1}{2}$  loosely coiled slender whorls. Adult sculpture of rather distant heavy rounded axials, vertical, and continuously in line from whorl to whorl; surface otherwise smooth. Aperture long and narrow, with subparallel sides, ending in a short very shallowly notched anterior canal. Outer lip strengthened by a heavy rounded varix, its inner edge smooth except for a weak denticle at the lower edge of the sinus, which is a shallow subsutural concavity. Inner lip smooth callused, defined by an incised outer edge. Colour yellowish-brown with distant reddish-brown lines. Range — Known only by the type species which is Recent, from the Mediterranean.

Genus CYTHARELLA Monterosato, 1875,

Bull. Soc. malac. Ital. 1, 1, p. 73 (sic *Cyharella*). Type (s.d. Woodring, 1928) *Murex costatus* Donovan, 1803 (not *Pleurotoma bertrandi* Payraudeau, 1826, designated by Dall, 1918, Proc. U.S. Nat. Mus. 54, p. 325; invalid since species not in Monterosato's original list). Syn. *Rissomangilia* Monterosato, 1917, Boll. Soc. zool. Ital. 3, 4, p. 24. Type (monotypy) *Pleurotoma bertrandii* Payraudeau, 1826. = *Citharella* (error pro *Cyharella*), Thiele, 1929, Handb. Syst. Weicht. 1, p. 366.

Plate 15, fig. 21

Shell small, 5-10 mm., eucitharid-like, but without apertural processes, ovate-biconic, with spire and aperture of about equal height. Protoconch tall, narrowly conical of 2-3 smooth rounded whorls. Adult sculpture of rather distant heavy rounded axial ribs, which rise above the suture, but are approximately in line from whorl to whorl. Suture strongly undulated by the axials. Surface crossed by numerous spiral lirations, strongest in the spaces between the

axials. Aperture long, narrowly ovate, terminating in a short channelled but unnotched anterior canal. Outer lip with a heavy rounded varix. Sinus subsutural, a weak concavity, restricted by the varix. Inner lip a narrow defined callus. No apertural tubercles or processes. Range — Typically Recent, from England to the Mediterranean, the Pleistocene, and Pliocene of England, France and Italy and the Miocene and Eocene of France.

The genus has been applied rather widely for Recent shells from California and West Mexico, but these, although of similar general facies to *Cytharella*, have atypical nuclear whorls; for them Dr Myra Keen prefers *Tenaturris* (1958, Sea Shells of Tropical West America, p. 474). From the Dainti Pliocene of Japan, Makiyama (1927, Mem. Coll. Sci. Kyoto Imper. Univ. ser. B, 3, 1, pp. 110, 111) described two new species of *Cytharella*, but only one of them, *hiradoensis*, may prove to belong to the genus. A Zanzibar lower Miocene species, *tenuifilosa* Cox, 1927 (Neog. and Quatern. Moll. Zanz. Prot. p. 32) resembles *Cytharella* but has an atypical protoconch. Also Olsson's *Cytharella limata*, from the Miocene of Costa Rica (Bull. Amer. Paleont. 9, 77) does not resemble the genus.

CHARACTERISTIC SPECIES—

Recent — *costatus* (Donovan, 1803), *bertrandii* (Payraudeau, 1826), *rugulosum* (Philippi, 1844). Pleistocene — *smithii* (Forbes, 1840). Pliocene — Miocene — *costatus* (Donovan, 1803), *mitrula* (Sowerby, 1822), *rugulosum* (Philippi, 1844), *simplior* and *turonensis* (Peyrot, 1938), Eocene — *labratula* (Cossmann, 1889).

Genus CLATHROMANGELIA Monterosato, 1884,

Nomencl. Conch. medit. p. 131. Type (monotypy) *Pleurotoma granum* Philippi, 1844.

Plate 15, fig. 17

Shell small, 5-6 mm., narrowly ovate, with a moderately tall spire and an ovate body-whorl, terminating in a very short weakly emarginate anterior canal. Protoconch papillate of  $1\frac{1}{2}$  whorls, sculptured with granulose spiral threads, followed by an angulate whorl of closely spaced axials, crossed by two weak spiral cords. Adult sculpture coarsely clathrate, consisting of heavy rounded axials, overridden by almost equally strong spiral cords, which are gemmulate to subspinose at the points of intersection; two spiral cords on the spire whorls. Aperture narrow, with parallel sides. Outer lip with a heavy external varix, and callus-ridged within, the callus bearing 3 or 4 rather strong tubercles. Sinus subsutural, a shallow but distinct excavation of the outer lip. Inner lip with a narrow defined callus but no processes. Colour pale yellowish-brown. Range — Typically, Recent, Mediterranean and Miocene of France, Hungary and Italy. The genus has been recorded also from the Recent fauna

of North West America and the Eocene of Egypt, but verification is required. The Indonesian *corbula* Thiele, 1925 resembles *Clathromangelia* in general facies but has a different protoconch.

#### CHARACTERISTIC SPECIES—

Recent — *clathrata* (Marcel de Serres, 1829), *quadrillum* (Dujardin, 1837) (= *granum* Philippi, 1844 and *rude* Philippi, 1836), *strigilata* Pallary, 1904. Miocene — *clathrata* (Marcel de Serres, 1829), *duperrayi* (Peyrot, 1903), *quadrillum* (Dujardin, 1837).

#### Genus GLYPHOTURRIS Woodring, 1928,

Carnegie Inst. Wash. Publ. no. 385, p. 177. Type (o.d.) *Mangilia quadrata rugirima* Dall, 1889.

##### Plate 15, fig. 22

Shell small, 5-6 mm., stout, white, ovate-biconic-fusiform. Protoconch small tipped, of between 2 and 4 rapidly enlarging whorls, smooth except for the last half whorl or more, which is sculptured with curved protractive axial riblets. Adult sculpture of prominent axial ribs, overridden by strong spiral cords and microscopic 'frosted' spiral threads. Aperture short and rather narrow, terminated in a short, sub-tubular, weakly notched anterior canal. Outer lip varicose, with a moderate arcuate sinus, occupying most of the shoulder slope. Interior of the outer lip generally bearing a low broad denticle below the sinus, and another at the beginning of the anterior canal. Range — Recent Florida and West Indies, Miocene, Jamaica.

#### CHARACTERISTIC SPECIES—

Recent — *rugirima* (Dall, 1889). Miocene — *lampra* Woodring, 1928.

The genus resembles *Clathromangelia* in its adult facies but has different nuclear and apertural features.

#### Genus TENATURRIS Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 185. Type (o.d.) *Cythara guppyi* Dall, 1896.

##### Plate 15, fig. 12

Shell rather small, 6.7 - 9 mm., stout, ovate-fusiform, very slightly shouldered. Spire moderately tall and body-whorl slowly tapered to a short very shallowly notched anterior canal. Protoconch conical of  $2\frac{1}{2}$  whorls, the last one sculptured with axial riblets. Outer lip varicose, bearing within, a low broad denticle at the lower edge of the anal sinus; otherwise the inner and outer lips are without denticles. Sinus moderately deep and broadly rounded, extending from the suture to the weak peripheral angle. Adult sculpture of broadly rounded axial ribs, intermittently varicose, crossed by spiral threads. The genus is close to *Acmaturris* but is more cytharid in form, the sculpture less reticulate, the axials being dominant, and has the sinus immediately joining the suture. Range — Recent, Caribbean and tropical western American, Miocene of Jamaica.

#### CHARACTERISTIC SPECIES—

Recent — CARIBBEAN; *bartlettii* (Dall, 1889); *trilineata* (C. B. Adams, 1845); TROPICAL WEST AMERICA; *burchi* (Hertlein & Strong, 1951); *carissima* (Pilsbry & Lowe, 1932); *nereis* (Pilsbry & Lowe, 1932); *pyrrhula* (Dall, 1919); *taeniornata* (Pilsbry & Lowe, 1932); *verdensis* (Dall, 1919). Miocene — *guppyi* (Dall, 1896), *isiola* and *terpna* Woodring, 1928.

#### Genus ACMATURRIS Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 184. Type (o.d.) *Acmaturris comparata* Woodring, 1928.

##### Plate 15, fig. 24

Shell rather small, 8-11 mm., rather slender, with a tall spire and a long narrow aperture, gradually tapered to a short unnotched anterior canal. Protoconch broadly conical of about  $2\frac{1}{2}$  whorls, the last one obscurely keeled, and sculptured with protractive axial riblets. Outer lip strongly varicose, its outer edge crenulated. No internal apertural denticles or ridges, but a thick parietal callus pad adjoining the sinus, which is broadly rounded, moderately deep and occupies most of the shoulder slope. Adult sculpture clathrate, consisting of narrow axial ribs crossed by strong spiral threads. Range-Miocene of Jamaica.

#### CHARACTERISTIC SPECIES—

*brisis*, *comparata* and *scalida* Woodring, 1928.

#### Genus CRYOTURRIS Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 178. Type (o.d.) *Cryoturris engonia* Woodring, 1928.

##### Plate 15, fig. 18

Shell small, 4.6 - 11.4 mm., narrowly biconic, with an elongated spire, and whorls angulate to moderately rounded at the periphery. Protoconch slender of  $2\frac{1}{2}$  — 3 whorls, tip immersed, regularly increasing, smooth, except for the last whorl or half whorl, which bears curved protractive axial riblets. Aperture rather narrow, anterior canal very short, hardly differentiated, slightly emarginate. Outer lip simple, thin except at intervals corresponding to the position of varix-like ribs. Sinus wide, shallow to moderately deep, occupying most of the shoulder slope. Adult sculpture of low narrow axial ribs crossed by minutely granulate spiral threads. No apertural denticles or processes. Range — Recent — North Carolina, Florida and the Caribbean. Pliocene — Florida Miocene — North Carolina, Jamaica and Dominican Republic.

#### CHARACTERISTIC SPECIES—

Recent — *elata* (Dall, 1889); *fargoi* McGinty, 1955; *quadrilineata* (C. B. Adams, 1850). Pliocene — *serta* Fargo, 1953. Miocene — *aptera*, *dianema*, *etrema*, *engonia*, *euengonia*, *nexilis* and *nisis* Woodring, 1928; *daidalea* Gardner, 1937; *dominicensis* (Gabb, 1873); *hillsboroughensis* Mansfield, 1937; *lalonis* (Maury, 1917) and *magnoliana chariessa* Gardner, 1948.

#### Genus GRANOTURRIS Fargo, 1953,

Monog. 8, Acad. Nat. Sci. Phil. p. 394. Type (o.d.) *Granoturris padolina* Fargo, 1953.



## Plate 15, fig. 19

Shell small, 8.2 mm., with a very tall spire, small eliptioquadrangular aperture, terminated in a short barely emarginate anterior canal. Sinus very shallow to obsolete. Protoconch of  $1\frac{1}{2}$  — 2 smooth whorls, sometimes with a few weak axial riblets on the last whorl, followed by a weak submedian keel, preceding the adult sculpture. Adult whorls strongly medially sharply angulate, sculptured with broad low axials crossed by fine delicately incremented spiral threads. Outer lip thin. The genus belongs to the *Kurtziella-Cryoturris* group but has a different protoconch approaching that of *Glyphostoma*. Range — Known only by the type species from the Pliocene of North St. Petersburg, Florida.

Genus **SACCHAROTURRIS** Woodring, 1928, Carnegie Inst. Washington Publ. no. 385, p. 182. Type (o.d.) *Mangilia consentanea* Guppy, 1896.

## Plate 15, fig. 16

Shell of moderate size, 11.4 mm., slender, with sharply angulate whorls, strongly constricted at the sutures. Spire tall, turreted, body-whorl short, rapidly contracted to a short unnotched anterior canal. Protoconch of three rapidly increasing whorls, last two strongly keeled and bearing beads, from which fine axial riblets extend. Aperture wide, outer lip not varicose but incurved with a thin edge. Sinus broad and shallow. Adult sculpture of rather distant heavy varix-like axials, overridden by finely granulose spiral cords and threads. Somewhat related to *Mangelia* but the beaded protoconch is distinctive. Range — 100 fathoms off Barbados. Miocene, Florida and Jamaica.

## CHARACTERISTIC SPECIES—

Recent — *monocingulata* (Dall, 1889). Miocene — *consentanea* (Guppy, 1896); *centrodes* Gardner, 1937.

Genus **NOTOCYTHARELLA** Hertlein & Strong, 1955,

Bull. Amer. Mus. Nat. Hist. 107, 2 p. 232. Type (o.d.) *Cythereella niobe* Dall, 1919.

## Plate 15, fig. 23

Shell small, 4-8 mm., elongate-ovate, with a tall spire of lightly convex whorls and a long oval body-whorl, slowly contracted to a short, scarcely differentiated unnotched anterior canal. Protoconch of about three whorls, tip minute and translucent, first two whorls smooth, the last spirally lirate, crossed by finer radials, forming a reticulated pattern. Adult sculpture of broadly rounded axial folds, extending from suture to suture and over most of the body-whorl; overridden by spiral cords and intermediate threads. Aperture rather small and narrow; outer lip variced, interrupted above by a distinct subsutural, broadly rounded sinus of moderate depth. Both inner and outer lips smooth.

Hertlein and Strong compared their genus both with *Cythereella* Monterosato, 1875, a Recent European genus, and with *Agathotoma* Cossmann, 1899, the type of which is from the Miocene and Pliocene of Europe. The protoconch of *Cythereella* is tall and narrowly conical of 2-3 smooth rounded whorls; in *Agathotoma* it is of three whorls, the first two smooth, the last with strong axial ribs crossed by weak spiral striae.

Unfortunately I do not have the radula of the type species of *Notocythereella*, only that of *Clathurella panamella* Dall, 1908, which was admitted to the genus, with a query, by Keen (1958, Sea Shells of Tropical West America, p.473), and it, by its radula (USNM: 122771) is clavinid, with a prototypic formula, whereas typical *Notocythereella* belongs to the *Mangelinae*. Range — The Recent fauna of West America from California to Ecuador.

## CHARACTERISTIC SPECIES—

*ephaedra* (Dall, 1919), *hastula* (Pilsbry & Lowe, 1932), *hippolita*, *niobe* and *phaethusa* (Dall, 1919).

Genus **RUBELLATOMA** Bartsch & Rehder, 1939,

Proc. U.S. Nat. Mus. 87, no. 3070, p. 130. Type (o.d.) *Mangelia rubella* Kurtz & Stimpson.

## Plate 16, fig. 1

Shell small, 9-10 mm., fusiform, with a moderately tall spire of medially bluntly angulate whorls and a long ovate body-whorl, gradually contracted to a suddenly strongly flexed short unnotched anterior canal. Protoconch broadly conical of two strongly rounded smooth whorls, followed by a brief brephic stage of curved slender axial riblets. Adult sculpture of heavy broadly rounded axials, vertical from the shoulder downward, but reduced and concavely flexuous over the shoulder sulcus. Surface densely spirally lirate. Sinus shallow, broadly arcuate and on the shoulder sulcus. Outer lip thin edged but variced behind. Inner lip lightly callused. Coloration; usually broadly brown zoned over the lower half of the whorls. Range — Recent, south-eastern United States.

## CHARACTERISTIC SPECIES—

*diomedea* Bartsch & Rehder, 1939, *rubella* (Kurt & Stimpson).

Genus **STELLATOMA** Bartsch & Rehder, 1939,

Proc. U.S. Nat. Mus. 87, no. 3070, p. 132. Type (o.d.) *Mangelia stellata* Stearns, 1872.

## Plate 16, fig. 2

Shell small, 7-8 mm., solid, of eucitharid appearance, but without apertural processes other than one small tubercle, ovate-biconical, with the spire and aperture of about equal height. Protoconch small, globose, of  $1\frac{1}{2}$  smooth whorls, ending in a few brephic axials, before merging into the adult sculpture, which is of bold axial ribs, strongest at the peripheral

angle, then gradually diminishing below, the whole overridden by spiral threads, which are more distinct in the axial interspaces. Aperture narrowly lunate, ending in a short, undifferentiated, channelled but unnotched anterior canal. Outer lip thin-edged but strengthened behind by a heavy rounded varix; the interior with a callused ridge which bears a small tubercle above, at the lower edge of the sinus. Sinus subsutural, a shallow rounded cavity with a reflected edge. Inner lip a narrow smooth callus with a clearly defined edge. Colour pure white to pale buff, the anterior end and inside edge of the outer lip sometimes tinged with reddish-brown. Range — known only by the type species which is Recent from Florida.

#### Genus KURTZIA Bartsch, 1944,

Proc. Biol. Soc. Washington 57, p. 63. Type (o.d.) *Mangilia arteaga* Dall & Bartsch, 1910.

##### Plate 16, fig 3

Shell small, elongated-conic, 10.25 mm. Protoconch of  $1\frac{1}{2}$  smooth whorls, then a fraction of a whorl showing two weak spiral threads, followed by two whorls of strongly developed protractively curved axials, crossed by two spiral cords, one of which forms the strong median angulation. Adult sculpture of long strong axials, extending from suture to suture and over the entire base, the whole fenestrated by crisp spiral cords, of which the uppermost and strongest marks the sharply angulate shoulder. Finer axial and spiral threads granulate the entire surface. Aperture narrowly elongate-ovate. Outer lip thin; with a broad moderately deep sinus, occupying the whole of the shoulder slope. Anterior canal of moderate length, with an unnotched termination. Operculum thin, oval, with a terminal nucleus. The radula (*arteaga*; text fig. F145) consists of a pair of hilted-dagger style marginals, each with a conspicuous basal spur.

Range — The type species is Recent from Barkley Sound, Vancouver Island to San Diego and occurs also in the Pleistocene of San Pedro. Bartsch (1944, 1.c.) stated that the genus included a number of species on the West Coast, ranging from British Columbia to Panama, but did not mention them by name.

#### CHARACTERISTIC SPECIES—

*arteaga* (Dall & Bartsch, 1910) and subsp. *roperi* (Dall, 1919), *gordonii* Bartsch, 1944.

#### Genus KURTZIELLA Dall, 1918,

Proc. Biol. Soc. Wash. 31, p. 137. Type (o.d.) *Pleurotoma cerina* Kurtz & Stimpson, 1851.

##### Plate 16, fig. 4

Shell small, 4.5-13 mm., of light build, elongate-biconic, with a tall spire and a long relatively narrow angulated body-whorl, tapered to a short but widely open unnotched anterior canal. Protoconch of  $2-2\frac{1}{2}$  regularly increasing whorls, the last reticulated by pro-

tractive axial riblets crossed by three or four spiral threads. Adult sculpture of regular prominent but rather narrow axials, somewhat thickened at the peripheral angle, overridden by dense spiral lirae. Aperture ovate-quadrangle; outer lip thin edged. Sinus a broadly open V, its apex a little above the peripheral angle. Inner lip plain, without processes. Colour white or buff. Radula-of the hilted-dagger type, a pair of moderately long simple pointed marginals, each with a prominent basal spur (*cerinella*; text fig. F147 and *danae* text fig. F148). Range — Recent, North Carolina to Florida and California, Pliocene and Miocene of Florida and Venezuela. The genus has been recorded also from the Pliocene of Japan, with the species *hobasiensis* and *ugali* Makiyama, 1927, but confirmation is required.

#### CHARACTERISTIC SPECIES—

Recent — *alesidota* (Dall, 1920), *cerina* (Kurtz & Stimpson, 1851), *cerinella* (Dall, 1889), *danae* (Dall, 1919), *eritima* (Bush, 1885), *limonitella* (Dall, 1883), *perryae* Bartsch & Rehder, 1939, *tersa* Dall, 1920. Pliocene — *limonitella* subsp. *margaritifera* Fargo, 1953, *morona* Weisbord, 1962. Miocene — *caribbeana* Weisbord, 1962, *precerina* Pilsbry & Harbison, 1933, *prionota* Gardner, 1937, *ramondi* (Maury, 1910), *stephanophora* and *thektapleura* Gardner, 1937, *tropica* and *venezuelana* Weisbord, 1962, *websteri* (Maury, 1910).

#### Genus KURTZINA Bartsch, 1944,

Proc. Biol. Soc. Washington 57, p. 64. Type (o.d.) *Mangilia* (*Kurtziella*) '*beata*' (sic) = *beta* Dall, 1919.

##### Plate 16, fig. 5

Shell small, 5 — 9.2 mm., ovate to elongate-conic. Protoconch obtuse, of two strongly rounded smooth whorls, succeeded by a stage in which axial and spiral threads cross, their points of intersection being nodulose. Adult whorls strongly medially angulated, crossed by strong long flexuous axials, which extend from suture to suture and over the entire base. Secondary sculpture of dense finely granulose spiral threads. Aperture ovate; outer lip thin, with a broad shallow sinus, occupying the whole of the shoulder slope. Operculum narrow and slender, with a terminal nucleus. Radula (*cyrene*; fig F146) of dagger-shaped marginals with a weakly developed basal spur.

The genus is very similar to *Kurtzia*, except for a slightly different protoconch, a narrower operculum, and an overall subequal granulate spiral sculptured surface, instead of a clathration between axials and spirals, plus finer granulate threads. Range — Recent from California to Panama.

#### CHARACTERISTIC SPECIES—

*antiochroa* and *antipyrgus* (Pilsbry & Lowe, 1932), *beta* (Dall, 1919), *cymatias* (Pilsbry & Lowe, 1932), *cyrene* (Dall, 1919).

#### Genus BELLASPIRA Conrad, 1868,

Amer. Journ. Conch. 3, p. 261. Type (monotypy) *Mangilia virginiana* Conrad, 1862.



## Plate 16, fig. 6

Shell very small, 4.5 mm., ovate-biconic, with the spire height about equal to that of the aperture, and conspicuously sculptured with long rounded axials. Whorls strongly convex, except for a weak angulation at about two thirds whorl height. The nuclear whorls are missing in the type specimen. Adult sculpture of strong vertical bluntly rounded axials, 10-12 per whorl; interspaces with much weaker spiral cords, three on the spire whorls, the uppermost at the weak shoulder angle. In addition there are seven closely spaced oblique threads at the end of the columella. Aperture proportionately large, ovate, ending in a channeled, very weakly notched and very short anterior canal. Outer lip strengthened behind by a heavy varix. Sinus a shallowly concave sub-sutural excavation, limited in depth by the labial varix. Inner lip an adpressed smooth cal-lus.

Conrad's original figure is small, and in accurate, being much too narrow, as shown by comparison with Bartsch & Rehder's photograph of the actual type (1939, Proc. U.S. Nat. Mus. 87, no. 3070, pl. 17, fig. 6). Range — The type species is from the Yorktown formation, Miocene of Virginia.

Since the nuclear whorls of the type of *virginiana* are unknown, and the specimen apparently remains unique, reference of other species to the genus can be only approximate. Schwengel (1940, Nautilus, 54, 2, p.51) described a *Bellaspira* (?) *pentapleura* from 45 fathoms off Palm Beach, Florida. This recalls the genus in a general way but is probably not related; it looks clavinid, whereas Conrad's species probably belongs with the mangeliids or eucitharids.

Beets (1946, Meded. Geol. Sticht. ser. C, 4, 6, p.104) used *Bellaspira* for an English Pliocene clavinid, quite unlike Conrad's genus.

## Genus GURALEUS Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Mangelia picta* Adams & Angas, 1864.

## Plate 16, figs. 7, 8

Shell small, 3.4-12 mm., elongate-fusi-form, tall-spined, usually turreted, and with a narrow body-whorl, gradually tapered to a relatively short weakly notched anterior canal. Protoconch small, broadly conical, with a small smooth symmetrical nucleus, second whorl also smooth but much larger, the third whorl with fine axial riblets, gradually merging into the adult sculpture. Adult sculpture with the axials dominant and usually crossed by weak cords and fine threads. Aperture rather narrow, with a thin outer lip. Sinus a broad shallow excavation, occupying most of the shoulder slope. Colour ranging from white or uniform buff to subsutural maculations and obscure interrupted spiral lines. Range — Re-

cent, south-eastern Australia and Tasmania to Western Australia, the Pliocene of South Australia and the Miocene of Victoria. The Recent Japanese *octangulata* (Dunker, 1860), referred to *Guraleus* by several Japanese authors, is not closely related.

## CHARACTERISTIC SPECIES—

Recent — *asper* Laseron, 1954, *bordaensis* Cotton, 1947, *brazieri* (Angas, 1871), *cusps* and subsp. *connectens* (Sowerby, 1896), *diacritus* Cotton, 1947, *fascinus* and subsp. *stephenensis* Hedley, 1922, *flavescens* (Angas, 1877), *florus* Cotton, 1947, *fossa* Laseron, 1954, *incrusta* (Tension-Woods, 1877) (= *st-gallae* Tension-Woods, 1877), *nanus* Laseron, 1954, *picta* (Adams & Angas, 1864) and subsp. *vincentina* Crosse & Fischer, 1865, *tasmanis* and subsp. *tritonus* Laseron, 1954. Pliocene — *adelaidensis*, *chapplei* and *ludbrookae* Powell, 1944. Miocene — *harrisii* Powell, 1944.

Subgenus EUGURALEUS Cotton, 1947, (of *Guraleus*),

South Austr. Naturalist 24(3), p. 15. Type (o.d.) *Euguraleus anisus* Cotton, 1947.

## Plate 16, fig. 9

Shell small to moderate sized, 4.8-15.5 mm. The members of this Miocene to Recent Australian subgenus closely resemble the New Zealand Oligocene to Pliocene *Fusiguraleus*, except for the form of the anterior end, which gradually tapers to a relatively long unnotched and non flexed anterior canal, the columella not defined by an excavated neck. The protoconch is of three whorls, faint axials appearing at the end of the second whorl, but relatively strong on the third. The protoconch, therefore, is nearer to that of *Guraleus* than to that of *Neoguraleus*, which is fenestrated over the last one or two whorls. It is doubtful if *Euguraleus* warrants segregation from *Guraleus*. Range — Recent, New South Wales, Tasmania and South Australia.

## CHARACTERISTIC SPECIES—

Recent — *anisus* (Cotton, 1947); *thornleyanus* (Laseron 1954); *jacksonensis* (Angas, 1877); *tasmanicus* (Tension-Woods, 1876) and subsp. *peronianus* (Laseron, 1954).

Subgenus MITRAGURALEUS Laseron, 1954, (of *Guraleus*),

Handb. Roy. Zool. Soc. N.S.W., p. 32. Type (o.d.) *Bela mitralis* Adams & Angas, 1864.

## Plate 16, fig. 10

Shell of moderate size, 12-18 mm., ovate, mitriform; spire conical, very little taller than aperture height; whorls rounded, without a shoulder. Protoconch small, narrowly conical, of three whorls, first two smooth, the third with axial riblets. Adult sculpture of numerous broadly rounded axials, which extend from suture to suture and over the entire base, their interstices with numerous fine spiral threads. Aperture narrowly ovate, ending in a short slightly flexed anterior canal, with a shallowly notched, oblique termination. Sinus subsutural, a very slight broad concavity. Outer lip thin



and no apertural processes. Colour uniformly pale buff, sometimes with a subsutural zone of light brown, occupying the sinus area. Range, Recent, New South Wales and Tasmania to South Australia.

CHARACTERISTIC SPECIES—

*australis* and *mitralis* (Adams & Angas, 1864).

Genus NEOGURALEUS Powell, 1939,

Rec. Auck. Inst. Mus. 2(4), p. 236. Type (o.d.) *Drillia sinclairi* Gillies, 1882.

Plate 16, fig. 11

Shell small, 6-14 mm., broadly to elongately fusiform, with a tall spire but a truncated anterior end. Adult sculpture of bold long axials, usually undiminished over the weak shoulder slope, extending from suture to suture and over the base, crossed by weaker overriding cords or with intercostal lirae. Aperture ovate, terminated in a very short weakly notched and slightly flexed anterior canal. Colour buff to light brown, sparsely banded in darker reddish-brown, continuous or interrupted by the axials or sometimes basally zoned and with a paler peripheral zone. Outer lip thin with a broad shallow sinus occupying the shoulder slope. The whorls are either evenly rounded or weakly subangulate.

Operculum very thin and rudimentary, of much smaller size than the aperture, ovate to leaf-shaped and with a terminal nucleus. Radula (text figs. 132-136), a pair of marginals, variable between species but always more or less of the hilted dagger type. In some species (*sinclairi*), the teeth are broad, short and obliquely triangular, with a more or less straight but oblique base, having an upcurved spur at the upper extremity and a thickened tongue at the lower end, from which extends a hilt that is not part of the tooth, but a muscle extension that acts as an insertion plate. In other species (*interruptus*, *murdochi*, *amoenus*, *tenebrosus* and *whangaroaensis*), the marginals are of the normal hilted dagger type, the hilt being part of the tooth. Specific individuality is exhibited in the length relative to the breadth of the tooth and the degree of development of the lateral spur.

Unfortunately the radula of *Guraleus* is unknown, and I have no information regarding the presence or absence of an operculum in that Australian genus. The main differentiating character separating the genus from *Guraleus* is the protoconch, which is of three whorls also, but only the tip is smooth, the other two being fenestrated by axials and spirals.

The genus has been wrongly applied to North German and French Miocene species by Sorgenfrei (1958, Geol. Surv. Denmark 2, no. 79 (2), pp. 278-282). The species cited were *Daphnella* (*Raphitoma*) *calais* and *Mangilia* *gurichi* (Kautsky, 1925) and *Pleurotoma* *tenella* Mayer, 1858, but the protoconch is

atypical in all three. Also two species from the Pliocene or Miocene of Okinawa were ascribed to *Neoguraleus* by Mac Neil (1960, U.S. Geol. Surv. Prof. Paper 339, p. 115). One of these *loochooensis*, has the latter part of the protoconch fenestrated, and could be a *Neoguraleus*, but the other, *kutekinensis*, has a blunt smooth protoconch of 1½ whorls and thus could qualify for inclusion in *Antiguraleus*, but the apertural features are unknown.

Range — New Zealand, Oligocene to Recent, and possibly the Miocene or Pliocene of Okinawa.

CHARACTERISTIC SPECIES—

Recent—NEW ZEALAND; *amoenus* (Smith, 1884), *benthicola* and *finlayi* Powell, 1942, *huttoni* (Smith, 1915), *interruptus* Powell, 1942, *lyallensis* (Murdoch, 1905), *murdochi* (Finlay, 1924 (= *corrugata* Murdoch, 1900), *manukauensis*, *oruaensis* and *sandersonae* Powell, 1942, *sinclairi* (Gillies, 1882) (= *sinclairii* E. A. Smith, 1884), *tenebrosus* (Powell, 1926), *whangaroaensis* Powell, 1942. Pleistocene — *finlayi* Powell, 1942, *hautotaraensis* Vella, 1954, *morgani* (Marwick, 1924), *nukumaruensis* Powell, 1942, *protensa* (Hutton, 1885), Pliocene — *lineatus* (Marwick, 1928), *ngatuturaensis* (Bartrum & Powell, 1928), *waihuaensis* Powell, 1942. Oligocene — *deceptus* Powell, 1942. Miocene — Pliocene, OKINAWA; *loochooensis* Mac Neil, 1960.

Subgenus FUSIGURALEUS Powell, 1942 (of *Neoguraleus*),

Bull. 2, Auck. Inst. Mus. p. 139. Type (o.d.) *Clathurella leptosoma* Hutton, 1885.

Plate 16, figs. 12, 13

Shell small to moderate sized, 4.5-15.6 mm., elongate-fusiform, with a tall spire and a relatively long, slightly flexed unnotched anterior canal. The subgenus is a New Zealand lower Tertiary forerunner of the New Zealand upper Tertiary and Recent *Neoguraleus*. Both show close resemblance to the Australian *Guraleus*, which has an Oligocene to Recent range. Members of the subgenus *Fusiguraleus* are always separable from *Neoguraleus* and *Guraleus* by the form of the anterior end, which is not truncated, but produced into a relatively long, only slightly flexed anterior canal, marked off from the body-whorl by an excavated neck. Most species of *Guraleus* and *Neoguraleus* have a truncated anterior end, with a relatively short canal. In elongate-fusiform *Guraleus*, such as *G. (Euguraleus) tasmanicus* (Tenison-Woods, 1876), the body-whorl is slowly tapered to the anterior canal but without an excavated neck. Range — New Zealand, from the Oligocene to the lower Pliocene, but most of the species are from the Oligocene.

CHARACTERISTIC SPECIES—

Oligocene — *flexicostatus* Powell, 1942; *gracilentia* (Suter, 1917); *lawsi* Powell, 1942; *leptosoma* (Hutton, 1885); *major*, *mancus*, *nutans*, *porrectus*, *rari-costatus*, *subobsoletus* and *sutherlandicus* Powell, 1942. Miocene — *angustatus*, *exsculptus*, *granulatus*, *marwicki*, *platycostatus* and *rigidus* Powell, 1942. Pliocene — *sata* (Laws, 1936).



## Genus ANTIGURALEUS Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 146. Type (o.d.) *Antiguraleus otagoensis* Powell, 1942. Syn.? *Paraguraleus* Powell, 1944, Rec. Auck. Inst. Mus. 3(1), p. 49. Type (o.d.) *Guraleus (Paraguraleus) balcombensis* Powell, 1944.

## Plate 16, figs. 14, 15

Shell small to moderate sized, 6-15 mm., fusiform, with the spire slightly taller than the aperture plus the canal, which is of moderate length, rather straight, and very shallowly notched. In general facies the genus is similar to both *Guraleus* and *Neoguraleus*, but with one important difference, the protoconch, which is paucispiral, asymmetrical, of  $1\frac{1}{2}$  smooth whorls, papillate, the tip small and tilted, then rapidly inflated, more bulging on one side, clearly marked off from the adult sculpture, but without a brephic stage. Operculum absent. Radula consisting of a pair of long slender rather straight hollowed marginals, gradually tapered to a simple sharp point; the base a moderate hilt, with a conspicuous upcurved spur (*murrheus*; text fig. E138).

When *Paraguraleus* was proposed, it was on the assumption that it represented a mutation from *Guraleus*, and that its New Zealand analogue, *Antiguraleus* originated in a similar manner from local stock in *Neoguraleus*. At that time it was assumed that a paucispiral globular protoconch signified a sedentary type of mollusc. However, this seems now, not to be the case, as evidenced by the wide distribution of other turrids with a blunt paucispiral nucleus, notably "*Pseudoinquisitor*" and *Lophioturris*. Therefore, unless tangible evidence to the contrary is forthcoming, it is more realistic to consider *Antiguraleus* and *Paraguraleus* to be identical. Range — Miocene to Recent of New Zealand and Oligocene to Recent of New South Wales to South Australia.

## CHARACTERISTIC SPECIES—

(*Antiguraleus*): Recent — NEW ZEALAND; *abernethyi* Dell, 1956; *fenestratus* Powell, 1942; *fusiformis* Dell, 1956; *infanda* (Webster, 1906); *multistriatus* Dell, 1956; *munda* (Suter, 1909); *murrheus* (Webster, 1906); *otagoensis* and *pedicus* Powell, 1942; *pulcherrimus* Dell, 1956; *rossianus* and *subtruncatus* Powell, 1942. Pleistocene — *abnormis* (Hutton, 1885); *deceptus* Powell, 1942; *makaraensis* Vella, 1954. Miocene — *taranakiensis* (Marwick, 1926); *rishworthi* Vella, 1954.

(*Paraguraleus*): AUSTRALIA; Recent — *adcocki* (Sowerby, 1896); *alternatus* (Laseron, 1954); *costatus* (Hedley, 1922); *emina* (Hedley, 1905) and subsp. *brevostium* (Laseron, 1954); *howelli* (Laseron, 1954); *kingensis* (Petterd, 1879) (= *cognata* Pritchard Gatliff, 1899); *lucidus* (Laseron, 1954); *permutatus* (Hedley, 1922); *serpentis*, *subitus* and *tepidus* (Laseron, 1954). Pliocene — *abbreviatus* and *incisus* (Powell, 1944), Miocene — *balcombensis* (Powell, 1944); *obsoleta* (Harris, 1897). Oligocene — *finlayi* (Powell, 1944).

## Genus MARITA Hedley, 1922,

Rec. Aust. Mus. 13 (6), p. 312. Type (o.d.) *Cithara compta* Adams & Angas, 1863.

## Plate 16, fig. 16

Shell of moderate size, 11-15 mm., elongately ovate, of cytharid facies, with a short broadly conical spire, and a long ovate body-whorl, slowly tapered to a short spout-like, unnotched anterior canal. Protoconch small, of three rounded whorls, two smooth but the third with weak axial riblets. Adult sculpture of numerous rather narrow axials, extending from suture to suture on the spire-whorls but becoming subobsolete over the body-whorl. The whole surface is incised with linear grooves, strongest encircling the anterior end. Aperture very long and narrow, with a rather deeply channelled subsutural sinus, somewhat constricted above by a thickening of the parietal callus. Outer lip thin edged, but heavily variced behind; no apertural processes. Colour uniformly buff to light brownish. The heavily variced outer lip, definite posterior sinus and general facies of the shell suggest alliance with *Eucithara* rather than with *Guraleus*. Range — Recent, New South Wales and Tasmania to South Australia.

## CHARACTERISTIC SPECIES—

*bella* (Adams & Angas, 1864); *compta* (Adams & Angas, 1864) (= *varix* Tenison-Woods, 1877); *elongata* and *tumida* Laseron, 1954.

## Genus VEXIGURALEUS Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 145. Type (o.d.) *Vexiguraleus clifdenensis* Powell, 1942.

## Plate 16, fig. 17

Shell small, 5.2 mm., ovate-fusiform, with weakly shouldered whorls. Protoconch conical, of four whorls, tip small of  $1\frac{1}{2}$  smooth whorls, followed by two glossy whorls, sculptured with concavely arcuate axial threads, crossed on the last quarter to half whorl by four very weak narrow spirals, and ending in a slight varix. The adult sculpture is of moderately strong flexuous axial folds, overridden by distant spiral threads and dense much weaker interstitial lirations. Outer lip apparently thin, and with a broad, very shallow subsutural sinus. Aperture elongate-pyriform, terminating in a short, only slightly twisted, unnotched anterior canal. There are no apertural processes. Range — Known only by the type species, which is from the Altonian lower Miocene of Clifden, Southland, New Zealand.

The Japanese lower Pliocene *Etremella* has a similar protoconch to that of *Vexiguraleus*, and they may prove to be identical, but I have not been able as yet to compare the relevant material.

## Genus ETREMELLA Makiyama, 1927,

Mem. Coll. Sci. Kyoto Imper. Univ. ser. B, 3 (1), p. 112. Type (o.d.) *Cytherea totomiensis* Makiyama, 1927.

## Plate 16, fig. 18

Shell small, 5.4 - 7.4 mm., elongately fusiform-ovate, with a tall narrowly conical spire

of gradate rounded whorls and a narrow body-whorl, terminated in a short unnotched or feebly notched anterior canal. Protoconch conical of four whorls, the first two smooth, the remainder sculptured with numerous fine concavely arcuate riblets. Adult sculpture openly clathrate, consisting of long narrowly crested axial folds, overridden by a few narrow spiral cords, two on the spire-whorls and about five on the body-whorl and base. Outer lip apparently thin (broken in the type specimen), incurved subvaricose in the subspecies *tachymorpha*. Sinus deep, rounded, subsutural. Apparently no apertural denticles or plications. The genus appears to have nearer relationship to *Guraleus* than to *Etrema*. Range — Lower Pliocene of Dainiti and Honohasi, Kakegawa series, Japan.

CHARACTERISTIC SPECIES—

*totomiensis* and subsp. *tachymorpha* (Makiyama, 1927).

A possible synonym is *Vexiguraleus* Powell, 1942, the type of which is from the Altonian Miocene of Clifden, Southland, New Zealand.

Genus **TURRELLA** Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W., p. 36. Type (o.d.) *Clathurella tenuilirata* Angas, 1871.

Plate 16, fig. 19

Shell small, 6.7 - 12.5 mm., fusiform, with a tall turreted spire but a truncated body-whorl, ending in a short weakly notched anterior canal. Protoconch small, typically of two whorls, the first smooth, the apex slightly inrolled, the second developing axial ribs. In some species the protoconch is nearer to that of *Guraleus*, that is, of three whorls, first two smooth, the third with fine axials which merge into the adult sculpture. Adult sculpture of narrowly rounded axials, extending from suture to suture and over the base, often in line from whorl to whorl, as in *Pseudoraphitoma*; spiral sculpture overriding the axial, and consisting of crisp cords and dense granular threads. Aperture narrowly ovate, without denticles and with a thin outer lip. Sinus deep and rounded, sometimes rim-margined, and occupying most of the shoulder slope. The genus has a deep and more definitely formed sinus than in any other of the *Guraleus* series, and the dense granulate-thread subsidiary sculpture is another distinctive feature. Range, Recent, New South Wales and Tasmania.

CHARACTERISTIC SPECIES—

*asperima*, *crassa* and *gracilis* Laseron, 1954; *granulosissima* (Tenison-Woods, 1879); *letourneauxiana* (Crosse & Fischer, 1865); *morologus* (Hedley, 1922); *subcostata* Laseron, 1954; *tenuilirata* (Angas, 1871).

Genus **LIRACRAEA** Odhner, 1924,

Vidensk. Medd. fra Dansk nat. Foren. 77, p. 44. Type (o.d.) *Clathurella epentroma* Murdoch, 1905.

Plate 16, figs. 20, 21

Shell small, 4-8 mm., narrowly fusiform to

cylindrical, with a tall attenuated spire and a truncated body-whorl terminated in a short broadly and shallowly notched anterior canal. Protoconch most distinctive, moderately large, paucispiral, with a blunt inrolled tip, and boldly sculptured with three spiral keels. Adult sculpture of narrowly rounded but strong axials, extending from suture to suture and over the base, overridden by crisp spiral cords. Sculpture varying between axial dominance to an even fenestration. Outer lip thin, no apertural processes. Sinus very shallow, occupying the shoulder slope. Colour buff to light reddish-brown, without maculations. Operculum rudimentary, approaching vestigial, its height about one third that of the aperture plus the canal, leaf-shaped, with a terminal nucleus. Radula, (*odhneri*; text fig. E137), a pair of marginals of the hilted dagger type, ending in a simple sharply tapered point and with an upcurved spur on one side, between the tooth proper and the hilt.

Except for the distinctive protoconch of a few strong spiral keels, and usually a much narrower shell shape, the genus is closely similar to *Neoguraleus*. Range — Recent and Pleistocene, New Zealand, including the Chathams and Auckland Islands.

CHARACTERISTIC SPECIES—

Recent — *benthicola* Dell, 1956; *epentroma* (Murdoch, 1905); *odhneri*, *otakaui* and *subantarctica* Powell, 1942; *whangaroensis* (Murdoch, 1905). Pleistocene — *dictyota* (Hutton, 1885); *titirangiensis* Marwick, 1928.

Genus **MACTEOLA** Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Purpura* (*Cronia*) *anomala* Angas, 1877.

Plate 16, fig. 22

Shell small, 7-11 mm., broadly-biconical, solid, with angulate whorls and bold broadly rounded axials, absent from the shoulder slope and fading out over the base, the whole surface crowded with fine spiral threads. Protoconch cylindrical of two smooth whorls, with a blunt tip. Aperture sub-ovate, terminated in a short unnotched anterior canal. Outer lip thin, with a broad but very slight arcuate sinus, occupying most of the shoulder slope. Colour white with a subperipheral band of brown, broken up into a series of rectangular spots by the axials. Sometimes there is a basal band of maculations as well, and except in the type species, the maculations are usually composed of four or five closely spaced lines. Range — Recent Indo-Pacific, Reunion to the Philippines, Japan, Hawaiian Islands, Loyalty Islands, Queensland and New South Wales to Western Australia and New Zealand.

CHARACTERISTIC SPECIES—

*anomala* (Angas, 1877), *interrupta* (Reeve, 1846), *sandersonae* (Bucknill, 1927), *segesta* (Chenu, 1850) (= *bella* Pease, 1860 = *gemmulata* Deshayes, 1863), *theskela* (Melvill & Standen, 1895). Note — Bucknill's *sandersonae*, from New Zealand, seems to belong here rather than in *Scrinium*.



Genus PSEUDORAPHITOMA Boettger, 1895,

Nachr. deutsch. Malak. Gesell. 27, p. 56. Type (o.d.) *Mangelia fairbanki* G. & H. Nevill, 1875.

Plate 15, fig. 24

Shell small, 4-11 mm., solid, elongate-subcylindrical, with a tall spire and a relatively short and narrow body-whorl, ending in a short weakly notched anterior canal. Protoconch broadly conical of three whorls, first two smooth, the third axially costate. Aperture narrow with a heavily variced outer lip; the sinus a moderately deep rounded excavation over the shoulder area of the varix. Inner edge of the outer lip with several moderately strong denticles. Adult sculpture most distinctive, consisting of narrowly crested axial ridges, continuously in line from whorl to whorl, and separated by wide concave interspaces. Colour white to unicoloured buff or light brownish. Range — Tropical Indian Ocean to the Philippines and Japan, eastern and southern Australia; also recorded from the Pliocene of Japan and Okinawa.

CHARACTERISTIC SPECIES—

Recent — *alma* Thiele, 1925, *alticostata* (Sowerby, 1896), *anna* Thiele, 1925, *axicula* and *bipyramidata* Hedley, 1922, *cognata* Thiele, 1925, *crudelis* Hedley, 1922, *darnleyi* (Brazier, 1876), *fairbanki* (G. & H. Nevill, 1875), *hexagonalis* (Reeve, 1845) (= *agna* Melvill & Standen, 1896), *informis* Hedley, 1922, *multigranosa* (Schepman, 1913), *paula* Thiele, 1925, *pyramidula* Laseron, 1954, *pyramis* (Hinds, 1843) (= *obeliscus* Reeve, 1846), *severa* Thiele, 1925, *styracina* and *transitans* Hedley, 1922, *tropica* Thiele, 1925. Pliocene — *naganumaensis* Otuka, 1935, *nakosiensis* Nomura & Zinbo, 1936.

Genus ITHYCYTHARA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 168. Type (o.d.) *Mangilia psila* Bush, 1885.

Plate 16, fig. 23

Shell small, 4-9 mm., elongately-ovate with a tall spire, a narrow body-whorl, tapered to a short, oblique, shallowly notched anterior canal, but a heavily variced and arcuately flared outer lip. Protoconch of 2½-3 rapidly increasing whorls, the last with weak protractive axial riblets, and sometimes keeled. Inner lip with a deeply set denticle just above middle height and some smaller denticles below. A feature of the shell is the prominent, rather distant, vertical, rounded axials, which are aligned from whorl to whorl as in *Pseudoraphitoma*. Range — Southeastern United States, the Caribbean and Brazil. Pliocene, Florida, Miocene, Florida, Jamaica and Dominican Republic. Oligocene, Florida.

CHARACTERISTIC SPECIES—

Recent — S.E. UNITED STATES; *psila* (Bush, 1885); CARIBBEAN; *lanceolata* and *muricoides* (C. B. Adams, 1850); *parkeri* Abbott, 1958. BRAZIL; *hyperlepta* Haas, 1953. Pliocene — FLORIDA; *kellumi* and *maera rata* Fargo, 1953. Miocene — FLORIDA; *defuniaki* and *radinos* Gardner, 1937; CARIBBEAN; *elongata* (Gabb, 1873); *ischna*, *maera*, *psiloides* and *scissa* Woodring, 1928. Oligocene — FLORIDA; *tarri* and subsp. *strabonis* Maury, 1910.

Genus MANGAOPARIA Vella, 1954,

Trans. Roy. Soc. N.Z. 81 (4), p. 552. Type (o.d.) *Mangaoparia powelli* Vella, 1954.

Plate 16, fig. 25

Shell small, 5.3 mm., solid, biconical, strongly but bluntly angulate, with distant prominent bluntly rounded axials, commencing strongly, almost nodulose at the periphery and then gradually diminishing, finally fading out at the neck, crossed by weak spirals from the periphery downward, those around the neck and anterior end somewhat stronger. Subsutural fold narrow on the early whorls, broader and subobsolete over later whorls. Shoulder sulcus broad, smooth and deeply concave. Protoconch rather large, of a little more than one whorl, smooth and glossy, the tip large, eccentric and a little flattened. Sinus on the shoulder slope, very shallow. Aperture incomplete but indicated as narrowly subovate with a thin outer lip, lightly callused but ill defined inner lip, and terminated in a short unnotched or weakly notched anterior canal. Range — Known only by the type species which is from the Tongaporutuan upper Miocene of South-East Wairarapa, New Zealand.

The relationships of the genus are obscure; its author suggested either the Borsoniinae, close to *Awateria* or *Guraleus*, in the Mangiliinae. A further possibility, and a more likely one, is near affinity to the Austro-Indo-Pacific mangelinid genus *Macteola*.

Genus PARACLATHURELLA Boettger, 1895,

Nachr. Bl. dtsh. malak. Ges., 27, p. 56. Type (o.d.) *Pleurotoma gracilentia* Reeve, 1843.

Plate 17, fig. 1

Shell small, 4-12 mm., elongate-fusiform, with a tall spire of loosely coiled weakly angulated whorls, and a long narrow body-whorl, gradually tapered to a moderately long shallowly notched anterior canal. Protoconch turbinate of two smooth whorls, followed by a whorl, sculptured with 4 or 5 granulose spirals. Adult sculpture of numerous long fold-like axials, extending from suture to suture and over most of the base, overridden by crisp narrow spiral cords and intermediate threads. The shoulder slope, which occupies the upper third of the whorl height, is crossed by fine spiral threads as well as the axials, but the spiral cords extend only from the shoulder angle to the lower suture. Aperture long and narrow. Outer lip heavily variced and with a broadly incurved sharp free edge. Sinus a deep rounded U, occupying most of the shoulder slope. Upper edge of sinus drawn forward at the suture to a heavy parietal callus pad. Colour uniform white to buff. Range — Indo-Pacific, Persian Gulf to Indonesia, Philippine Islands, Queensland, and off Angola, West Africa.



## CHARACTERISTIC SPECIES—

INDO-PACIFIC — *aditicola* and *clothonis* Hedley, 1922, *gracilentia* (Reeve, 1843) (= *contracta* Reeve, 1843 = *fusoides* Reeve, 1846 = *elegantissima* Melvill & Standen, 1903 = *portia* Smith, 1884), *padanensis* and *thecla* Thiele, 1925. WEST AFRICA — *densegranosa* Thiele, 1925.

Genus EUCLATHURELLA Woodring, 1928, Carnegie Inst. Wash. Publ. no. 385, p. 187. Type (o.d.) *Clathurella vendryesiana* Dall, 1896.

## Plate 17, fig. 2

Shell of moderate size, 13.8 mm., elongate-fusiform, with a tall slender spire and a long body-whorl, gradually tapered to a rather long unemarginate anterior canal. Protoconch of about 2 whorls, broad-tipped, smooth, except for the last half whorl or so which is sculptured with axial riblets. Outer lip varicose, with a very broad and shallow stromboid notch. Sinus deep, its apex broadly rounded. Inner lip thin and detached but with a greatly thickened parietal callus adjoining the sinus. Sculpture of narrow axial ribs, overridden by closely spaced spiral threads. Range — Miocene of Jamaica, Dominican Republic and Panama.

The genus is superficially very similar to *Paraclathurella*, which differs, however, in having a notched anterior canal and a differently sculptured protoconch that is of two smooth whorls followed by a whorl of granulose spirals.

## CHARACTERISTIC SPECIES—

*vendryesiana* (Dall, 1896), *gertrudis* (Toula, 1909) (may be a synonym of *vendryesiana*).

Subgenus MIRACLATHURELLA Woodring, 1928 (of *Euclathurella*),

Carnegie Inst. Washington Publ. no. 385, p. 189. Type (o.d.) *Miraclathurella vittata* Woodring, 1928.

## Plate 17, fig. 3

Shell of moderate size, 12-15.5 mm., of almost identical facies to *Euclathurella* except for an extra whorl on the protoconch, a deeper stromboid notch and the addition of a sub-sutural cord. Protoconch stout, broad-tipped, consisting of between 2½-3 whorls, the end of the last whorl bearing a few coarse curved protractive axial riblets, in front of which may lie a keel. Aperture very long and narrow. Anterior canal relatively long and slightly emarginate. Sinus deep, apex broadly rounded, somewhat constricted at the entrance by callus, both at the top of the inside of the labial varix and the parietal wall. Adult sculpture of numerous rather narrow axial ribs, overridden by strong spiral cords. Range — Miocene of Dominican Republic, Jamaica and Mexico.

## CHARACTERISTIC SPECIES—

*amica* (Pilsbry & Johnson, 1917); *entemna* Woodring, 1928; *gracilis* (Gabb, 1873); *subconsors* (Bose, 1910); *vittata* Woodring, 1928.

Genus CROCKERELLA Hertlein & Strong, 1951,

Zoologica (New York), 36 (2), p. 78. Type (o.d.) *Clathurella crystallina* Gabb, 1865).

## Plate 17, fig. 11

Shell small, 3.8-4.8 mm., ovate-fusiform, with a moderately tall spire of medially strongly angulate whorls, and a narrowly ovate body-whorl, ending in an undifferentiated short weakly notched anterior canal. Protoconch of two whorls, the first very small, smooth, the second much larger, angulated medially, and sculptured with a fine spiral cord on the angle and numerous fine axial riblets (not "nucleus smooth", as stated in Hertlein & Strong's introduction of the genus, p. 78). Adult sculpture of strong axial ribs extending from suture to suture and over most of the base, the whole overridden by spiral cords and threads. Aperture narrowly ovate; outer lip strongly varicose, smooth within, except for a slight callus at the lower extremity of the sinus, which is a broadly rounded, rather shallow subsutural excavation. Inner lip not callused and without denticles or processes. Colour white, sometimes obscurely brown banded at the suture. Radula (*crystallina*, text fig. E143), a pair of long slender, straight, gradually tapered simple marginals, without barbs, and with only a slightly expanded base. Range — Catalina Island, California to the Gulf of California.

The genus resembles *Philbertia*, which however differs notably in having a diagonally cancellated protoconch.

## CHARACTERISTIC SPECIES—

*crystallina* (Gabb, 1865), *hilli* and *pedersenii* Hertlein & Strong, 1951, *subdiaphana* (Carpenter, 1864).

Genus EUCITHARA Fischer, 1883,

Man. Conchyl. p. 593. Type (monotypy) *Mangelia stromboides* Reeve, 1846 (= *Cythara* auct.).

## Plate 17, fig. 4

This name was proposed by Fischer to replace *Cythara* Schumacher, 1817, upon the erroneous assumption that Schumacher's name was preoccupied by Klein, 1753, which is not the case, since Klein's names are non-binomial. However, although Schumacher's *Cythara* is valid from a nomenclatural standpoint its identity remains obscure.

The type of Schumacher's genus is his *striata*, based upon Martini-Chemnitz (Conch. Cab. 4, pl. 142, fig. 1330). This figure (Pl. 17, fig. 4) shows the dorsal aspect only of a narrow lyrate shell, not unlike the turrids, long known as *Cythara* auct., but with one important difference, the anterior end is a tapered curved spout, not a notched canal. However the situation is complicated by the fact that Röding (1798, Mus. Boltenianum, p. 51., no. 657) named a *Pterygia subterranea*, based upon the Conchylien Cabinet figure 1330, and again, Lamarck (1822, Anim. sans vert. 7, p. 115) named a *Cancellaria citharella*, based upon the same Martini-Chemnitz figure.

Reeve (1846, Conch. Iconica. 3, sp. 5, pl. 1) identified and figured one of the large Philippine Island "citharids" as Lamarck's species,



under the genus *Mangelia*, and also cited the Conchylien-Cabinet figure in the synonymy, and so by stages, the concept has arisen, that the shell so inadequately figured in Martini-Chemnitz equals *Cythara* of subsequent authors.

I concur with Hedley (1922, Rec. Austr. Mus. 13, pp. 260, 261), who summed up the situation adequately in his remark — “Even if it be granted that Schumacher’s *Cythara* is really a turrid, it is a species unknown to modern conchology, and the genus has no substantial basis”.

The only possibility of evaluating Schumacher’s *Cythara* is to locate the type specimen which could still be at present unidentified item in the Chemnitz collection, which is in the University Museum, Copenhagen. Meanwhile I follow Hedley and others in the use of Fischer’s *Eucithara*, which does have a well known species as its type, and is unquestionably turrid.

There is a parallel case in *Melatoma*, which most writers consider a nomen dubium, since the type species has neither since been recognised, nor is it known to be still in existence.

Shell fusiform to ovate-biconical, solid, of moderate size, up to 22 mm., but mostly within the size range of 5-12 mm. Protoconch small, erect, narrowly conical of  $2\frac{1}{2}$  whorls, first  $1\frac{1}{2}$  whorls smooth with an inrolled tip, the last whorl with numerous concavely arcuate thin axials, ending abruptly at the commencement of the post-embryonic sculpture. Adult sculpture of bold lyrate axial ribs, overridden by spiral cords and threads. Aperture long and narrow, as long as, to even longer than the spire, and terminating in a short, often undifferentiated, distinctly notched anterior canal. Outer lip strengthened by a heavy external varix, which is excavated or channelled sub-suturally by a moderately deep rounded sinus. Both the inside of the outer lip and the columellar lip with numerous plicae or denticles. Colour usually white, with or without intermittent brown bands, sometimes blotched in brown on the dorsal surface of the body-whorl and the anterior end. Range — Recent, abundantly represented throughout the Indo-Pacific, from Mauritius to Japan, Hawaii, northern Australia and the islands of the South West Pacific. Pleistocene of Japan, Pliocene of Java and Australia and Miocene of Borneo.

#### CHARACTERISTIC SPECIES—

Recent — *abbreviata* (Garrett, 1873), *abyssicola* (Reeve, 1846), *alacris* Hedley, 1922, *albivestis* (Pilsbry, 1934), *amabilis* (G. & H. Nevill, 1874), *antillarum* (Reeve, 1846), *arenivaga* Hedley, 1922, *articulata* (Sowerby, 1894), *bicolor* (Reeve, 1846), *brocha* Hedley, 1922, *caledonica* (Smith, 1882), *capillacea* (Reeve, 1846), *capillata* (Hervier, 1897), *castanea* (Reeve, 1846), *celebensis* (Hinds, 1843), *cincta* (Reeve, 1846), *cinnamomea* (Hinds, 1844), *cithara* (Gould, 1851), *columbelloides*, *coniformis* and *conohelicoides* (Reeve, 1846), *coronata* (Hinds, 1843), *crassilabrum* (Reeve, 1846), *crystallina* (Hervier,

1897), *cylindrica* (Reeve, 1846), *decussata* (Pease, 1867), *delacouriana* (Crosse, 1869), *diaglypha* (Hervier, 1898), *dubiosa* (G. & H. Nevill, 1875), *duplaris* (Melvill, 1923), *edithae* (Melvill & Standen, 1901), *elegans* (Reeve, 1846), *elevata* (Smith, 1884), *ella* (Thiele, 1925), *funiculata*, *fusiformis*, *gibbosa* and *gracilis* (Reeve, 1846), *gruveli* (Dautzenberg, 1932), *guentheri* (Sowerby, 1893), *hirasei* (Pilsbry, 1904), *interstriata* (Smith, 1876), *isseli* (G. & H. Nevill, 1875), *lamellata* (Reeve, 1846), *lepidella* (Hervier, 1897), *lyra*, *lyrica* and *marginelloides* (Reeve, 1846), *matakuaana* (Smith, 1884), *monochoria*, *miriamica* and *moraria* Hedley, 1922, *nana* (Reeve, 1846), *nevilliana* (Preston, 1904), *novae-hollandiae*, *obesa*, *pallida*, *planilabrum*, *ponderosa* and *pulchella* (Reeve, 1846), *quadrilineata* (Sowerby, 1913), *reticulata* (Reeve, 1846), *richardi* (Crosse, 1869), *semizonata* (Hervier, 1897), *solida* (Reeve, 1846), *souverbiei* (Tryon, 1884), *striatissima* (Sowerby, 1907), *stromboides* (Reeve, 1846), *subgibbosa* and *subglobosa* (Hervier, 1897), *tenebrosa* (Reeve, 1846), *typhonota* (Melvill & Standen, 1901), *turricula* and *vexillum* (Reeve, 1846), *vitiensis* (Smith, 1884), *vittata* (Hinds, 1843), *waterhousei* (Smith, 1884), *zonata* (Reeve, 1846). Pleistocene — *rugosolabata* (Yokoyama, 1922). Pliocene — *glabra* (Harris, 1897), *oppenoorthi* Oostingh, 1938. Miocene — *sawitrae* (Beets, 1941).

Subgenus **LEIOCITHARA** Hedley, 1922 (of *Eucithara*),

Rec. Austr. Mus. 13, 6, p. 268. Type (o.d.) *Mangelia infulata* Hedley, 1909.

#### Plate 17, fig. 6

Hedley introduced *Leiocithara* as a subgenus of *Eucithara* “For a group of smooth shells having the contour of *Eucithara* but without the characteristic grain sculpture”. The following species were included — *apollinea* (Melvill, 1904), *infulata* (Hedley, 1909), *pellucida* (Reeve, 1846) and *trivittata* (Adams & Reeve, 1850).

The type species is very small, 3.55 mm., is strongly axially ribbed, the axials overridden at the periphery by a strong spiral cord; otherwise the surface is smooth or weakly spirally lirate, except for a few spiral cords at the base of the pillar. The aperture bears a small tubercle, high up on the inside of the outer lip, and another opposite, on the parietal wall.

Of the species listed by Hedley, *pellucida* and *trivittata* have multiple denticles on the inside of the outer lip, and are typical *Eucithara*, apart from their small size, which is not significant.

Inclusions in *Leiocithara*, apart from the type species, could be *apollinea* (Melvill, 1904) and *macrocephala* and *musae* (Thiele, 1925). These shells have strong axial ribs, connected across the shoulder angle by a strong spiral cord, and two or three denticles only, in the upper part of the aperture, whereas *Eucithara* typical has numerous plicae or denticles down the entire length of both the outer and inner lips.

Range — Recent, off Zanzibar, Gulf of Oman, Sumatra and North Queensland, 50-132 metres.

## Genus ANACITHARA Hedley, 1922,

Rec. Aust. Mus. 13 (6), p. 300. Type (o.d.) *Mangilia naufragi* Hedley, 1909.

## Plate 17, fig. 7

Shell small, 3.5-8.7 mm., solid, similar to *Eucithara* but with a shorter more widely open aperture, which has a variced outer lip but no denticles or processes either within the outer lip or on the columella. The protoconch is small, bluntly rounded to dome-shaped of 2-3 smooth whorls, followed by a brephic stage of curved axial riblets. The adult sculpture is of long bluntly rounded axial folds, overriden by dense spiral lirae. Range — Recent — North Queensland, Loyalty Islands, New Caledonia and Arabian Sea. Oligocene of Tasmania, Oligocene to Miocene of New Zealand and probably the Pliocene of Java and Japan.

Several of Hedley's inclusions do have definite apertural processes, so these are excluded from the following list.

## CHARACTERISTIC SPECIES—

Recent — *brevicostata* and *caelatura* Hedley, 1922, *conata* (Hedley, 1909), *exquisita*, *hebes* and *her-vieri* Hedley, 1922, *lita* (Melvill & Standen, 1896), *naufraga* (Hedley, 1909), *phyllidis* and *propinqua* Hedley, 1922, *querna* (Melvill, 1910), *rissoina*, *robusta*, *stricta* and *tumida* Hedley, 1922. Pliocene — JAPAN, *bulbosa* Shuto, 1961. JAVA, *mantjeurien-sis* Oostingh, 1938. Miocene — NEW ZEALAND, *clifdenica*, *errabunda*, *finlayi* and *nana* Powell, 1942. Oligocene — NEW ZEALAND, *axialis* (Marshall, 1918). TASMANIA, *janjukiensis* Powell, 1944.

Subgenus ANACITHAROIDA Shuto, 1965 (of *Anacithara*),

Mem. Fac. Sci. Kyushu Univ. ser. D, Geol. 16, 2, p. 182. Type (o.d.) *Anacithara* (*Anacitharoida*) *kurodae* Shuto, 1965.

## Plate 17, fig. 8

It is very doubtful if this subgeneric name is worthy of recognition, since the only apparent distinguishing feature from *Anacithara* is a small difference in the protoconch. Both have a bluntly rounded paucispiral protoconch; that of *Anacithara* is followed by a brephic stage of curved axial riblets; that of *Anacitharoida* develops a weak peripheral carina towards its close, and is not followed by a brephic stage.

The presence or absence of a brephic stage cannot be considered of taxonomic importance since a brephic stage merely reflects an interim period of varying duration between larval and post-larval shell growth. Range — Known only by the type species which is from the Moeshima shell bed, upper Pleistocene, Kagoshima Bay, Japan.

## Genus CONOPLEURA Hinds, 1844,

Zool. "Sulphur", Moll. 1, p. 24. Type (monotypy) *Conopleura striata* Hinds, 1844 = *Pleurotoma partita* Reeve, 1846 (an unnecessary substitute name).? *Kenyonia* Brazier, 1896, Proc. Linn. Soc. N.S.W., p. 347. Type (monotypy) *K. pulcherrima* Brazier, 1896.

## Plate 17, fig. 16

Shell small, 8.2 mm., broadly biconical, resembling *Eucithara* in a general way but with several peculiar features. The shoulder sulcus is a series of deep pits, separated by thin radiating lamellae, the effect when viewed from above being like the spokes of a wheel. The axial sculpture is lyrate, in the form of broadly rounded flattened flexuous axials, which rise above the lower edge of the shoulder concavity, giving a serrated or coronated effect. The whole surface is crossed by a very distinctive type of spiral sculpture which is in the form of wavy oblique lirations, which widely diverge as the whorls increase. The aperture is narrow and sinuous, terminating in a short unnotched canal, and there is a slight false umbilicus. The outer lip is thin and has a deep narrow and oblique subsutural sinus, which is constricted at its entrance by a massive parietal callus pad. Colour dull white or buff. Range — New Guinea in 7 fathoms (type) and near the south coast of Timor in 34 metres (Schepman).

The genus is most distinctive but rather problematic regarding its relationships. Only study of the soft parts of this apparently very rare shell is likely to reveal the true systematic position of the genus, which for the present is aligned with eucitharids.

Brazier did not figure his *Kenyonia*, and the location of the unique type specimen is no longer known. This has led to speculation regarding the status of the genus, which was referred to the Turridae, with a query, by Dall (1918, Proc. U.S. Nat. Mus., 54, p. 327), as a synonym of *Ancistrostrix* by Wenz (1843, Handb. der Pal., 6, p. 1402), misquoted as "*Kennyonia*", and to the Conidae by Tomlin (1937, Proc. Malac. Soc., 22, p. 298).

However, the description of the type species, which was a Recent shell from the New Hebrides, suggests a shell similar to *Conopleura striata*.

The significant passage in Brazier's description is "tabled at the suture, each one being connected with small curious shelly plates that look like small deep pits when the shell is looked at end-on from the apex."

The dimensions given by Brazier for his species, height 28 mm., diameter 10 mm., indicates a much larger and proportionately narrower shell than the type of *Conopleura*, which is 8.2 mm. by 4.5 mm.

## Genus ETREMA Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Mangilia* (*Glyphostoma*) *aliciae* Melvill & Standen, 1895.

## Plate 17, fig. 9

Shell small to moderate sized, 3.5-20 mm., elongate-conic, solid. Protoconch small, 2-3 smooth globular whorls. Adult sculpture of prominent rounded ribs, usually swollen at the



periphery, but not extending either to the suture or over the base; overridden by crisp spiral cords and subsidiary lirations, which are sometimes granulose. Aperture usually about a quarter the total height, typically with a series of entering plications on both outer and inner lips. Outer lip strongly variced, often inwardly curved in a lamellate edge. Sinus rather deep, U-shaped, occupying the usually ill-defined shoulder slope, and frequently rendered sub-tubular by a prominent parietal callus pad or tubercle. Anterior canal short, weakly notched, often obliquely. Colour white, buff or brown, often obscurely zoned in darker brown, sub-suturally and on the base, and with diffused patches on both inner and outer lips. The parietal plications and denticles may be strong, weak or absent. For the latter state, *Etrempopa* Oyama, 1953 is available, but the evanescent character of the parietal processes is not considered to be of sufficient import to warrant full generic segregation of these variants. The Oligocene-Miocene New Zealand and Australian *Etrempopsis* Powell, 1942, also has the parietal processes obsolete but is distinctive as a genus, with its different protoconch, which is large, polygyrate and carinated. The tropical American Miocene to Recent *Glyphostoma* is close to *Etrema*, except for the protoconch which is of three smooth whorls, the last two carinated, and there is a very heavy development of denticles and ridges on both lips.

Range — Recent, Indo-Pacific, Madagascar to Japan and Australia, Oligocene to Pliocene of Australia, and doubtfully, the Oligocene of New Zealand, Miocene of Zanzibar, and Pliocene of Japan and Okinawa.

#### CHARACTERISTIC SPECIES—

Recent; INDO-PACIFIC (including QUEENSLAND); *acricula* Hedley, 1922; *aliciae* (Melvill & Standen, 1895); *aliphonsiana* (Hervier, 1915); *argillacea* (Hinds, 1843); *capillata* and *catapasta* Hedley, 1922; *crassilabrum* (Reeve, 1843); *culmea*, *curtisiana*, *elegans* and *firma* Hedley, 1922; *glabriplicata* (Sowerby, 1913); *labiosa* and *orirufa* Hedley, 1922; *perlissa* (Smith, 1904); *ravella* Hedley, 1922; *royi* (Sowerby, 1913); *spurca* (Hinds, 1843); *tortilabia* Hedley, 1922; NEW SOUTH WALES to SOUTH AUSTRALIA; *alliteratum* (Hedley, 1915); *bicolor* (Angas, 1871); *constricta* Laceron, 1954; *denseplicata* (Dunker, 1871) (= *atkinsoni* Tenison-Woods, 1876) and subsp. *kymatoessa* Watson, 1886); *kitcheni* and subsp. *attenuata* Laceron, 1954; *levicosta*, and *pyramis* Laceron, 1954; *paucimaculata* (Angas, 1880); *sparula* Hedley, 1922. Pliocene — VICTORIA; *gippslandensis* Powell, 1944; SOUTH AUSTRALIA; *weymouthensis* Ludbrook, 1958; JAPAN; *hyugaensis* Shuto, 1961; *saigoensis* Makiyama, 1927; OKINAWA; *sapliasi* Mac Neil, 1960; MIOCENE — VICTORIA; *bidens* (Tenison-Woods, 1879); *exsculpta* and *granolirata* Powell, 1944; *morningtonensis* Chapple, 1934; *obdita* (Harris, 1897); *turrita* Chapple, 1941; ZANZIBAR; *stockleyi* (Cox, 1927). Oligocene — TASMANIA; *janjukiensis* Powell, 1944; NEW ZEALAND;? *kaipara* Powell, 1942.

Subgenus ETREMOPA Oyama, 1953, (of *Etrema*),

Venus, 17 (3), p. 155. Type (o.d.) *Drillia subauriformis* Smith, 1879.

#### Plate 17, fig. 10

It is very doubtful if this name is worthy of recognition, even as a subgenus of *Etrema*. It was proposed for species of *Etrema* that lack denticles or plications on the inner lip, but resemble that genus in all other respects. Similar apertural features are found in *Etrempopsis*, but in that genus the protoconch differs considerably, in being large, smooth, of 5-6 whorls, all except the globular tip sharply carinated.

#### CHARACTERISTIC SPECIES—

(according to Oyama): Recent — JAPAN; *gainesii* (Pilsbry, 1895) (= *sawanensis* Yokoyama, 1927); *streptonotus* (Pilsbry, 1904); *subauriformis* (E. A. Smith, 1879); *texta* (Dunker, 1860); INDO-PACIFIC; *nassoides* (Reeve, 1843); *polydesma* (Hedley, 1922); *scalarina* (Deshayes, 1863). Pliocene — JAPAN; *saigoensis* (Makiyama, 1927).

The inner lip sculpture varies greatly in strength in *Etrema* and there are other species, apart from those listed by Oyama, that have the inner lip free, or almost free of processes.

#### Genus ETREMOPSIS Powell, 1942,

Bull. 2, Auck. Inst. Mus., p. 151. Type (o.d.) *Drillia imperfecta* Suter, 1917. Syn *Iraquetrema* Dance & Eames, 1966, Proc. Malac. Soc. 37 (1), p. 41. Type (o.d.) *Pleurotoma albata* Smith, 1882.

Shell small, 4-8 mm., very similar to *Etrema* but with a different protoconch, and no denticles on the columella or inner lip, other than an obsolete to moderate parietal tubercle. Protoconch large, smooth, of 5-6 whorls, the tip globular, the remainder carinated. Range—Oligocene and Miocene of New Zealand, Miocene of Victoria, Pliocene of South Australia, and Recent from the Persian Gulf.

The internally smooth outer lip, weak labial varix, and obtusely conical carinate protoconch, cited as the main diagnostic features of *Iraquetrema*, are matched exactly in *Etrempopsis*. The only difference from *Etrempopsis* is the complete absence of a parietal tubercle in *Iraquetrema*, but this feature is sometimes weak in the New Zealand Miocene species, and even absent in *clifdenica*.

#### CHARACTERISTIC SPECIES—

Oligocene—NEW ZEALAND; *aequisculpta* and *carnapex* Powell, 1942; *disposita* and *duospiralis* Laws, 1944; *elata* and *haroldi* Powell, 1942; *imperfecta* (Suter, 1917); *latiapex* and *oamarutica* Powell, 1942. Miocene — NEW ZEALAND; *clifdenica*, *compta*, *erecta* and *quadrispiralis* Powell, 1942; VICTORIA; *opposita* Powell, 1944. Pliocene — SOUTH AUSTRALIA; *contigua* Powell, 1944. Recent — PERSIAN GULF; *albata* (Smith, 1882).

#### Genus PSEUDOETREMA Oyama, 1953,

Venus, 17 (3), p. 154. Type (o.d.) *Drillia fortilirata* E. A. Smith, 1879.

#### Plate 17, fig. 14

Shell small, 4-14 mm., with a very tall and slender spire, heavily sculptured with prominent, broadly rounded axials, overridden by strong spiral cords. The genus is similar to



*Etrema* in general facies but lacks both labial varix and apertural denticles. Range — Recent and Miocene of Japan, and Pliocene of Formosa and Java.

CHARACTERISTIC SPECIES—

(according to Oyama): Recent — JAPAN; *fortilirata* (E. A. Smith, 1879); Pliocene — FORMOSA; *sintikuensis* (Nomura, 1935); JAVA; *gerthi*, *ijzermani* and *kaloedanensis* (Oostingh, 1938). Miocene; JAPAN; *hukusimensis* (Nomura & Zinbo, 1935).

Genus HETEROCITHARA Hedley, 1922,

Rec. Aust. Mus. 13 (6), p. 297. Type (o.d.) *Clathurella bilineata* Angas, 1871.

Plate 17, fig. 15

Shell small, 5-9 mm., ovate-fusiform, with a short rather narrow aperture. Protoconch typically broadly conical of two whorls, the first smooth, the second axially costate, but other species have from 3-4 whorls, with one or two whorls smooth and the remainder axially costate. Adult sculpture of strong axial ribs running from suture to suture and over the base, overridden by numerous crisp-spiral cords and dense intermediate threads. Outer lip strongly variced but excavated subsuturally by a shallow broadly rounded sinus; weak to strong denticles within. Outer lip with or without a parietal callus pad, but otherwise devoid of processes. Colour uniformly white or buff. Range — Recent, Philippines, and down the eastern coast of Australia to Victoria and New Zealand. Balcombian Miocene of Victoria and doubtfully the Opoitian lower Pliocene of New Zealand (i.e. *laterculus* Marwick has spirals as well as axials on the protoconch and the apertural details are unknown).

The genus resembles a narrowly ovate *Euclithara* but has a different, usually proportionately larger protoconch, no inner lip processes, and a densely lirate surface sculpture in addition to strong axials crossed by moderately strong spiral cords.

CHARACTERISTIC SPECIES—

Recent — *bilineata* (Angas, 1871), *concinna* and *erismata* Hedley, 1922, *mediocris* Odhner, 1924, *seriliola* and *transenna* Hedley, 1922, *zebuensis* (Reeve, 1846). Miocene — *miocenica* Powell, 1944. Pliocene? *laterculus* Marwick, 1931.

Genus APITUA Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W., p. 42. Type (o.d.) *Apitua delicatula* Laseron, 1954.

Plate 17, fig. 17

Shell small, 8 mm., white, narrowly ovate-biconical, with a tall spire of rounded whorls and an ovate body-whorl, slowly tapered to a short unnotched anterior canal. Protoconch very small, smooth, consisting of a minute depressed tip, followed by a larger depressed, medially carinated whorl. Adult sculpture of numerous long axial folds overridden by closely spaced crisp spiral cords. Aperture ovate; outer lip variced, the spiral sculpture continued over the slightly incurved front face; interrupted

above by a deep narrowly rounded subsutural sinus, which is somewhat constricted at its entrance by a moderate parietal callus pad. Range — known only by the type species which was dredged in Port Jackson, New South Wales.

The genus is probably nearest allied to *Heterocithara*, from which it differs in its small depressed carinate protoconch, and in the absence of labial denticles.

Genus APISPIRALIA Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W. p. 40. Type (o.d.) *Clathurella albocincta* Angas, 1871.

Plate 17, fig. 18

Shell small, 5.5-11 m.m., with a tall spire of rounded whorls and a rather broadly rounded body-whorl, which quickly contracts to a very short weakly notched anterior canal. Protoconch small, papillate, of 1½-2 whorls, tip blunt, smooth and slightly inrolled, second whorl microscopically spirally lirate. Adult sculpture of numerous strong elevated rounded axials, continuous from suture to suture and over the base to almost the anterior end; overridden by prominent spiral cords, which thicken into laterally elongated tubercles on the axial ribs. Aperture broadly ovate, outer lip variced and dentate within, interrupted above by a rather deep rounded sinus, with a reflected edge, and occupying most of the ill defined shoulder slope. Inner lip smooth but with a slight entering parietal callus pad. The genus somewhat resembles *Heterocithara*, but that genus has a different protoconch, which is broadly turbinate, with the tip smooth and the next whorl strongly axially costate. Range — Recent, New South Wales.

CHARACTERISTIC SPECIES—

*albocincta* (Angas, 1871), *catena* and *maxima* Laseron, 1954.

Genus FILODRILLIA Hedley, 1922,

Rec. Austr. Mus. 13(6), p. 220. Type (o.d.) *Drillia tricarinata* Tenison-Woods, 1878.

Plate 17, fig. 19

Shell small, 5.6-10 mm., thin, elongate-biconic, with a tall spire and a short body-whorl, ending in a short, straight, widely open, shallowly notched anterior canal. Protoconch large, smooth, of 1½ whorls. Adult sculpture predominantly spiral, a few sharp keels and subsidiary spirals, the keels usually smooth but sometimes crenulated by weak or subobsolete axials. Aperture ovate, without denticles; outer lip slightly expanded, thin edged with a deep, rounded subtubular sinus, occupying most of the shoulder slope. Colour uniformly white. The shells have much the appearance of *Etrema* but the sculpture is mainly of spiral keels and there is neither a labial varix nor are there apertural processes. Range — typically, Recent, the Australian continental shelf from



New South Wales, Tasmania and Victoria. Miocene and Pliocene species from Victoria and South Australia, with stronger axials, producing fenestration, are tentatively included in the genus.

CHARACTERISTIC SPECIES—

Recent — *haswelli* (Hedley, 1907); *mucronata* Hedley, 1922; *ordinata* Laseyron, 1954; *stadialis* Hedley, 1922; *tricarinata* (Tenison-Woods, 1878) and subsp. *intermissa* Laseyron, 1954; *teres*, *thornleyana* and *vitrea* Laseyron, 1954. Pliocene — *ludbrookae* Powell, 1944; *peramoena* (Ludbrook, 1941). Miocene — *turricula* Powell, 1944.

Genus LIENARDIA Jousseaume, 1884,

Bull. Soc. Zool. France 9, p. 184. Type (o.d.) *Clavatulula rubida* Hinds, 1843.

Plate 17, figs. 21, 22

Shell small, 4-16 mm., solid, usually brightly coloured, ranging from browns to pink and red, banded in white or dark-brown; ovate to cylindro-biconic, and strongly sculptured with broadly rounded axial ribs, overridden by sharp elevated spiral cords. Protoconch paucispiral, smooth, consisting of a small helicoid tip followed by a subglobose whorl, sometimes with a thread-like keel. Aperture rather narrow, terminating in a short rather deeply notched anterior canal. Outer lip strengthened by a heavy rounded varix, interrupted above by a deep U-shaped subsutural sinus. Both the inner and outer lips with series of strong denticles.

Operculum absent. Radula consisting of loose long slender sharply pointed awl-shaped marginals. These are shallowly excavated, almost to the tip, near which there is a slight indication of a barb, and the base is knuckle-shaped, of moderate development (*mighelsi*; text fig. E140). Range — Recent, Indo-Pacific, Mauritius to Red Sea, Indonesia, Philippines, Japan, Hawaiian Islands, north Queensland, New Caledonia and Kermadec Islands. Pliocene of Japan and Formosa. The genus resembles *Etrema*, which has, however, a tall narrowly tapered spire, and the labial varix is broadly reflected inward to a thin edge.

CHARACTERISTIC SPECIES—

Recent — *corticea* Hedley, 1922, *ecprepes* Melvill, 1927, *fallaciosa* Hedley, 1922, *fallax* (G. & H. Nevill, 1875), *falsaria* and *farsilis* Hedley, 1922, *giliberti* (Souverbie, 1874), *gracilis* Hedley, 1922, *immaculata* (Smith, 1876), *innocens* (Thiele, 1925), *lischkeana* (Pilsbry, 1904), *lutea* (Pease, 1860), *mighelsi* Iredale & Tomlin, 1917 (= *rugosa* Mighels, 1848), *multinoda* Hedley, 1922, *nigrocincta* (Montrouzier, 1872), *periscelina* Hedley, 1922, *peristernioides* Schepman, 1913, *perplexa* (G. & H. Nevill, 1875), *piperata* (Smith, 1882), *planilabrum* (Reeve, 1846), *ralla* Hedley, 1922, *rhodacme* (Melvill & Standen, 1896), *rosella* Hedley, 1922, *roseocincta* (Oliver, 1915), *roseotincta* (Montrouzier, 1872), *rubida* (Hinds, 1843), *vultuosa* (Reeve, 1845). Pliocene — *hayasakai* and *keiyukwana* Nomura, 1935, *sawanensis* (Yokoyama, 1926).

Subgenus ACRISTA Hedley, 1922 (of *Lienardia*),

Rec. Aust. Mus. 13(6), p. 285. Type (o.d.) *Lienardia punctilla* Hedley, 1922.

Plate 17, fig. 20

Shell small, 4-7 mm., biconical, but with the spire about 1½ times the height of the aperture, which is of trigonal shape, armed with a few strong processes; 2-3 large tubercles on the inside of the outer lip, and a very strong parietal tubercle, separated by a deep indentation from 2-3 distant plicae on the columellar callus. Protoconch cylindrical, of two smooth rounded whorls, the first turbinate and the second with a weak peripheral thread-like keel. Range — Recent, Indo-Pacific, Gulf of Oman, Zanzibar, North Queensland, Loyalty Islands, Samoa and Fiji.

The subgenus resembles *Thetidos*, but differs in having a smooth instead of a spirally grooved protoconch, and a decidedly trigonal aperture.

CHARACTERISTIC SPECIES—

*biplicata* (Melvill, 1906), *disconica* (Hervier, 1895), *fatima* (Thiele, 1925), *gaidei* (Hervier, 1895) *marchei* (Jousseaume, 1884) and subsp. *tuberculifera* (Hervier, 1896), *punctilla* Hedley, 1922, *semilineata* (Garrett, 1873).

Subgenus HEMILIENARDIA Boettger, 1895 (of *Lienardia*),

Nachr. Malak. Gesell. 27, p. 52. Type (o.d.) *Pleurotoma malleti* Recluz, 1852.

Plate 17, fig. 23

Shell small, 3.5-7 mm., ovate-biconical, solid, with strongly convex whorls, boldly sculptured with broadly rounded axials, overridden by crisp narrow spiral cords. Protoconch narrowly conical of 3½ smooth whorls. Aperture very narrow, terminated in a short weakly notched anterior canal. Outer lip much strengthened by a broad labial varix, crossed by the spiral cords, which at their termination, crenulate or denticulate the incurved edge of the lip. Columellar folds or plicae subobsolete or absent. Sinus deep, subsutural, with a rounded apex, rendered subtubular by encroachment of the labial varix. Colour of type species rose-red, with a snow-white protoconch and peripheral band. Members of the subgenus are usually brilliantly coloured, and frequent the shallow waters of coral reefs. Range — Recent, Indo-Pacific, Mauritius to Japan, Loyalty Islands, Samoa, Fiji and North Queensland.

The chief distinguishing character of the subgenus is the narrowly conical smooth white protoconch of 3½ whorls, which stands out, peg-like, from the adult shell.

CHARACTERISTIC SPECIES—

*apiculata* (Montrouzier, 1864) (and subsp. *albostrigata* (Baird, 1873), *calcicincta* (Melvill & Standen, 1895), *goubini* (Hervier, 1895), *hersilia* and *homochroa* Hedley, 1922, *malleti* (Recluz, 1852) (= *purpurescens* Dunker, 1871), *ocellata* (Jousseaume, 1884), *pinguis* (Garrett, 1873) (may = *malleti* Recluz, 1852), *thyridota* (Melvill & Standen, 1896).

Subgenus THETIDOS Hedley, 1899 (of *Lienardia*),

Mem. Aust. Mus. 3, p. 472. Type (o.d.) *Thetidos morsura* Hedley, 1899.

## Plate 18, fig. 1

Shell small, 5.5 mm., similar to typical *Lienardia* in general facies but with a blunt-tipped papillate protoconch of two spirally grooved whorls. The labial denticles are fewer and more massive, reduced to about three on the inner margin of the outer lip. Also, there is a deep rounded cleft in the parietal wall, immediately opposite to the uppermost labial denticle. Combined, these features considerably restrict the size of the aperture.

The subgenus *Acrista* also has a few strong labial denticles, but the aperture is trigonal, and the protoconch smooth. Range — The type species is from Funafuti Atoll in 40-80 fathoms. Probably other species listed under *Lienardia* typical, may belong here, but the nature of the nuclear sculpture, a deciding factor, is not known in every case.

## Genus NANNODIELLA Dall, 1919,

Proc. U.S. Nat. Mus. 56, p. 59. Type (o.d.) *Philbertia* (*Nannodiella*) *nana* Dall, 1919. (Name first proposed by Dall, 1918, Proc. U.S. Nat. Mus. 54, p. 329, but nom. nud. at that date since the type species was not described until 1919.)

## Plate 18, fig. 13

Shell small, 3.5-7 mm., slender or stoutly biconic, with a tall spire but a truncated base, ending in a short, straight, very weakly emarginate anterior canal. Protoconch of 4-4½ whorls, tip minute, globular, last one or two whorls with an angular keel. Aperture rather small, but with a conspicuous laterally projecting, spout-like anal sinus. Outer and inner lips typically smooth but denticles on one, the other, or both, in some species. Adult whorls angulate, with clathrate sculpture. The radula (*nana*; text fig. F144), consists of a pair of marginals, which are slender, sharply pointed, but not barbed. Range — Recent, Gulf of California, Panama, Florida and the Caribbean. Also represented by undescribed species from Hawaii, the Philippines and Indonesia. Pliocene of Florida and Ecuador. Miocene of Jamaica.

## CHARACTERISTIC SPECIES—

Recent, TROPICAL WEST AMERICA; *amyela* (Dall, 1919); *fraternalis* (Dall, 1919); *phylira* (Dall, 1919); *nana* (Dall, 1919). Pliocene; FLORIDA; *pauca* Fargo, 1953; ECUADOR; *meridionalis* Pilsbry & Olsson, 1941. Miocene; JAMAICA; *amicta* (Guppy, 1896); TRINIDAD; *rintriada* (Mansfield, 1925). Oligocene; FLORIDA; *nemorensis* (Maury, 1910).

## Genus GLYPHOSTOMA Gabb, 1872,

Proc. Acad. Nat. Sci. Phil. 24, pp. 270, 271. Type (monotypy) *Glyphostoma dentiferum* Gabb, 1872.

## Plate 18, fig. 2

Shell small to moderately large, 4.5-18 mm., fusiform-biconic, solid, the whorls angular or rounded, to bulging, but constricted at the sutures. Spire height usually greater than that of the aperture plus the canal. Protoconch of about three whorls, tip small, without sculpture

but a strong keel develops at the second whorl. Aperture usually long and narrow, with a short anterior canal, which is slightly recurved and notched at its termination. Outer lip strongly variced, and both outer and inner lips heavily sculptured with denticles and ridges. Anal sinus on the shoulder slope, wide, deep and often rim-margined, and the fasciole with strong growth wrinkles and obscure spirals. Sculpture of strong axial ribs crossed by spiral cords and threads. Radula (*gabbii*; text fig. E141), consisting of a pair of very long and slender curved marginals, with a sharp, non barbed, point. In another species (*immaculata*; text fig. E142), there is a medial serrated ridge, commencing a little short of the tip and extending almost two thirds of the length of the tooth. Range—Recent, Caribbean and tropical West America; Pliocene and Miocene of Florida, the Caribbean and the southeastern United States. *Glyphostoma* has been widely used for Recent Indo-Pacific species, but most can be accommodated in such genera as *Etrema* and *Lienardia*. Mac Neil (1960, U.S. Geol. Surv. Prof. Paper 339) used the genus for two Asiatic Pliocene species, the South Indian *costicrenata* (Cossmann, 1900), and the Okinawan *subcosticrenata* Mac Neil, 1960, but was unable to give protoconch details. Until the Indo-Pacific *Glyphostoma*-like species are individually assessed it is better to restrict the use of *Glyphostoma* to the tropical and subtropical American areas.

## CHARACTERISTIC SPECIES—

Recent — PUERTO RICO; *aguadillana* (Dall & Simpson, 1901); *elsae*, *epicasta* and *herminea* Bartsch, 1934; FLORIDA; *pilsbryi* Schwengel, 1940; CARIBBEAN; *gabbii* Dall, 1889; *gratula* (Dall, 1881) (= *incilis* Watson, 1881); *phalera* Dall, 1889; TROPICAL WEST AMERICA; *candida* (Hinds, 1843); *immaculata* Dall, 1908; *partefilosa* Dall, 1919; *thalassoma* Dall, 1908. Pleistocene; CALIFORNIA; *tridesmia* Berry, 1941. Pliocene — FLORIDA; *celosia*, *marionae*, *polysculptum*, *sapita* and *typhonoides* Fargo, 1953, *scoptes* Dall, 1903; *watsoni* Dall, 1890. Miocene — EASTERN and S.E. UNITED STATES; *belonoides* and *chipolanum* Gardner, 1937; *harrisi* Maury, 1910; *ischnon* Gardner, 1937; *johnsoni* Dall, 1892; *leonensis* Mansfield, 1930; *macneili* Mansfield, 1935; *nannophues* Gardner, 1937; *obtusa* (Martin, 1904); *peri-eilema* Gardner, 1937; *subflexuosa* (Whitfield, 1894); *tiarophoron* Gardner, 1937; *typhon* Gardner, 1937; *zoster* Gardner, 1948; CARIBBEAN & CENTRAL AMERICA; *addrina* Mansfield, 1925; *andersoni* Oinomiakado, 1939; *caronensis* Mansfield, 1925; *dalli* Bose & Toulia, 1910; *dentiferum* Gabb, 1872; *exopitatum* Woodring, 1928; *golfoyaquensis* Maury, 1917; *guppyi* Woodring, 1928; *mexicana* (Toulia, 1911); *triniada* Mansfield, 1925; *xeston* Gardner, 1937. Oligocene—FLORIDA; *aldrichi* Maury, 1910 (= *boadiceoides* Maury, 1910).

Subgenus GLYPHOSTOMOPS Bartsch, 1934, (of *Glyphostoma*).

Smithsonian Misc. Coll. 91 (2), p. 17. Type (o.d.) *Glyphostoma* (*Glyphostomops*) *hendersoni* Bartsch, 1934.

## Plate 18, fig. 3

Shell small, 9-12.4 mm. Very slender tall-spined glyphostomids with a flared variced



outer-lip, but no apertural denticles or processes other than a strong parietal callus pad, which renders the sinus subtubular. The spire is very tall and narrow, with rounded subangulate whorls. Body-whorl contracted rapidly to a moderately long anterior canal, with an oblique very weakly emarginate termination. Protoconch of  $2\frac{1}{2}$  whorls, the last one with a sub-median carina. Range — Recent, Puerto Rican Deep, 160-200 fathoms, and doubtfully, Pliocene, Florida.

CHARACTERISTIC SPECIES—

Recent: *hendersoni* Bartsch, 1934; *oenoa* Bartsch, 1934. Pliocene — ? *pinellasensis* Fargo, 1953.

Genus CLATHURELLA Carpenter, 1857,

Cat. Coll. Mazatlan Shells in the Brit. Mus. p. 399. Type (s.d. Cossmann, 1896) *Clavatula rava* Hinds, 1843.

Plate 18, fig. 4

This is one of the most widely misapplied generic names in the Turridae, occasioned by conflicting opinions regarding its status — i.e., whether simply a new name for the preoccupied *Defrancia* Millet, 1826 (non Bronn, 1825), or a new proposition to cover the two tropical West American species cited by Carpenter, namely, *Clavatula rava* Hinds, 1843 and *Clathurella aurea* Carpenter, n.sp.

Carpenter's footnote to his *Clathurella* reads— "This name is proposed for a convenient group of the *Mangelia* tribe; the name *Defrancia*, previously in use being preoccupied." Since Carpenter's work dealt exclusively with Mazatlan shells it seems reasonable to assume that his prime intention was to provide a new genus for his two West American shells, and that the name should not be considered exclusively a substitute one for the preoccupied *Defrancia*. I welcome, therefore, the application to the International Commission on Zoological Nomenclature by J. L. Bailly, to invoke the plenary powers of the commission to validate Cossmann's designation of *Clavatula rava* Hinds, 1843, as type of *Clathurella*, and trust that this course will be adopted.

Then *Defrancia* Millet, 1826, would become a synonym of *Pleurotomoides* Bronn, 1831. However, I disagree with Bailly's statement that *Philbertia* Monterosato, 1884, would become a junior objective synonym of *Clathurella* Carpenter, 1857. In my opinion *Philbertia* can be validly retained on the basis of *Pleurotoma philberti* Michaud, 1829 (in the synonymy of *Pl. bicolor* Risso, 1826), which is type by virtual tautonymy. Thus *Philbertia* becomes available in its normal usage for a large number of European and Indo-Pacific shells often attributed to *Clathurella* auct.

Shell small, 9.4 mm., solid, fusiform, with a tall spire of rounded whorls and a truncated body-whorl, terminated in a short widely open and weakly notched anterior end. Details of the protoconch unknown. Adult sculpture of

strong rounded axial ribs, extending from suture to suture and over the base, overridden by crisp narrow spiral cords. The surface is pebbled in places with minute pustules. The axial ribs extend weakly over the narrow anal fasciole, which is traversed by 5 or 6 fine spiral threads. Aperture ovate. Outer lip rather thin-edged, without a stromboid notch, strengthened behind by a strong varix, and with five or more strong teeth within the aperture, and more numerous denticles at the outer edge. Columellar lip with three short rather weak transverse folds. Sinus deep and rounded, rendered somewhat subtubular by a heavy parietal callus pad.

The genus is close to *Glyphostoma* from which it is distinguished chiefly by a shorter anterior canal, fewer and weaker columellar plicae, and a less impressed anal fasciole, which lacks the prominent subsutural spiral folds of that genus.

Range — Tropical West America, from the Gulf of California to Panama.

CHARACTERISTIC SPECIES—

(according to M. Keen, Sea Shells of Tropical West America, pp. 470-471). *affinis* Dall, 1871, *aurea* Carpenter, 1856, *intercalaris* (Carpenter, 1856), *rava* (Hinds, 1843), *rigida* (Hinds, 1843): and subsp. *fusciligata* (Carpenter, 1856) and *serrata* Carpenter, 1856.

Genus ADELOCYTHARA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 171. Type (o.d.) *Adelocythara primolevis* Woodring, 1928.

Plate 18, fig. 6

Shell small, 4.1 mm., bioconic-fusiform, with a moderately tall tabulated spire and a rather long body-whorl, slowly tapered to a short weakly emarginate anterior canal. Protoconch stout, broad-tipped, of  $1\frac{1}{2}$ -2 whorls last quarter whorl or less, with a few fine protractive riblets. Aperture long and narrow, the outer lip broadly variced, with a wide moderately deep sinus, occupying the shoulder slope. There is a strong denticle at the base of the sinus on the inner edge of the labial varix, the aperture otherwise devoid of denticles. Adult sculpture of bluntly rounded axial ribs crossed by spiral cords which commence at the peripheral angle, at a little below middle whorl height. Except for the protoconch which has only the last quarter whorl or less with fine axials, and the prominent denticle on the outer lip, the genus appears to be very close to *Platycythara*. Range — known only by the type species which is from the Miocene of Jamaica.

Genus BACTROCYTHARA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 174. Type (o.d.) *Cythara obtusa* Guppy, 1896.

Plate 18, fig. 5

Shell small, 5.4 mm., narrowly ovate-cylindrical, spire not shouldered and body-whorl



tall and narrow, very gradually tapered to a short, scarcely differentiated, distinctly emarginate anterior canal. Protoconch proportionately very large, of three whorls, small tipped, but rapidly enlarged, last  $1\frac{1}{2}$  whorls with closely spaced protractively arcuate axial riblets. Aperture very long and narrow. Outer lip varicose, base bearing a broad shallow stromboid notch. Anal sinus broad and deep constricted at its entrance by the labial varix and a thick parietal callus pad; no other apertural denticles or processes. Sculpture of flexuous narrow ribs and weak intercostal spiral threads. Range — Recent, Puerto Rico. Miocene, Jamaica.

CHARACTERISTIC SPECIES—

Recent — *asarca* (Dall & Simpson, 1901). Miocene — *obtusa* (Guppy, 1896).

Genus BRACHYCYTHARA Woodring, 1928, Carnegie Inst. Washington Publ. no. 385, p. 175. Type (o.d.) *Cythara gibba* Guppy, 1896.

Plate 18, fig. 7

Shell small, 4-8.6 mm., solid, biconic, turreted, medially angulate, with a long narrow aperture and base, gradually merged with a barely differentiated short, very shallowly emarginate anterior canal. Protoconch of 3 rapidly increasing whorls, tip small, last whorl with crowded protractive axial riblets. Outer lip slightly thickened, not varicose. Sinus broad and shallow occupying the shoulder slope. Parietal callus moderately thickened, adjoining the sinus. Interior of outer lip, in mature shells, with spiral lirae and sometimes a small denticle at the base of the sinus, otherwise the aperture is without denticles or processes. Sculpture of stout axials barely overridden by fine spiral threads. Range — Recent, Caribbean and West Mexico. Pliocene, Florida. Miocene, Florida, Jamaica and Dominican Republic.

CHARACTERISTIC SPECIES—

Recent — *biconica* (C. B. Adams, 1850). Pliocene — *galae*, subsp. *dimonia* and *gordonae* Fargo, 1953. Miocene — *gibba* (Guppy, 1896); *dasa* Gardner, 1937; *turrita* Mansfield, 1930.

Genus LIOGLYPHOSTOMA Woodring, 1928, Carnegie Inst. Wash. publ. no. 385, p. 193. Type (o.d.) *Lioglyphostoma adematum* Woodring, 1928.

Plate 18, fig. 16

Shell rather small, 6-15 mm., moderately slender, with a tall spire of subangulate whorls, and an elongated body-whorl, slowly tapered to a short slightly emarginate and recurved anterior canal. Protoconch of about  $3\frac{1}{2}$  smooth rapidly enlarging whorls, the last carinated. Adult sculpture of heavy axial folds, somewhat reduced over the shoulder area, overridden by strong spiral cords. Aperture narrow; outer lip strengthened behind by a heavy varix, and excavated above by a deep, U-shaped sinus, somewhat constricted at its entrance by

a heavy parietal callus pad; interior of the outer lip smooth, except for a slight thickening, both above at the sinus and below at the entrance to the anterior canal. Range — Recent, Lower California to Panama and the Galapagos, down to about 40 fathoms, Pliocene of Florida and Miocene of Costa Rica, Florida and Jamaica (type).

The two species recorded from the Pliocene of Okinawa, *chinensis* and *tenuata* Mac Neil, 1960, are more slender than typical *Lioglyphostoma* and the anterior canal is longer and spout-like; they are probably not congeneric.

The genus is like a small *Glyphostoma* that has lost both the apertural denticles and the wrinkles of the anal fasciole.

CHARACTERISTIC SPECIES—

Recent — *acapulcanum* Pilsbry & Lowe, 1932, *adana* and *adria* (Dall, 1919), *armstrongi* Hertlein & Strong, 1955, *crebriforma* Shasky & Campbell, 1964, *neglecta* (Hinds, 1843), *sculpta* (Hinds, 1843), *sirena* (Dall, 1919). Pliocene — *solia* and *woodringi* Fargo, 1953. Miocene — *adematum* Woodring, 1928, *moinica* (Olsson, 1922), *rusum* and *tyro* Gardner, 1937.

Genus PACHYCYTHARA Woodring, 1928, Carnegie Inst. Wash. publ. no. 385, p. 175. Type (o.d.) *Pachycythara cryptonata* Woodring, 1928.

Plate 18, fig. 8

Shell small, 6.2 mm., ovate-biconical, with a moderately tall spire of angulated whorls, and a long ovate-angulated body-whorl, considerably constricted over the neck, and ending in a very short barely emarginate anterior canal. Protoconch slender of about  $2\frac{1}{2}$  whorls, smooth except for obscure, curved, protractive axial riblets over the last quarter whorl. Adult sculpture of rather distant swollen axial ribs, overridden by a few sharply raised spiral cords, two on the spire whorls, the uppermost forming a peripheral carina at below middle whorl height. There is also a subsidiary surface sculpture of microscopic 'frosted' spiral threads. Aperture elongate-oval; outer lip varicose with a moderately deep U-shaped subsutural sinus, rendered somewhat constricted at its entrance by a parietal thickening of the inner lip callus. The genus resembles *Adelocythara* but has a more slender and more strongly sculptured nucleus, and the outer lip lacks the denticle below the anal notch. Both genera have an adult sculptural pattern resembling that of the Mediterranean genus *Clathromangelia*. Range — Known only by the type species from the Miocene of Bowden, Jamaica.

Genus PYRGOCYTHARA Woodring, 1928, Carnegie Inst. Washington Publ. no. 385, p. 171. Type (o.d.) *Pyrgocythara eminula* Woodring, 1928.

Plate 18, fig. 9

Shell small, 4.3-8.9 mm., slender, subovate, with a tall turreted spire, elongated body-whorl, tapered to a short weakly notched anterior canal, and sculptured with prominent but narrow, flexuous, citharid-like axials, over-



ridden by spiral threads. Protoconch of three whorls, the last two sculptured with distinct fine, curved, protractive axial riblets. Aperture long, moderately wide, with a variced outer lip and a wide deep sinus, bearing a denticle just below its lower edge. Range — Recent, Florida, Caribbean and tropical west America. Pliocene of Florida and Miocene of Jamaica. Note — *Mangelia* (*Pyrgocythara*) *bantamensis* Oostingh, 1938, from the Pliocene of South Bantam, Java, is unlikely to be congeneric with *Pyrgocythara*.

#### CHARACTERISTIC SPECIES—

Recent; FLORIDA and CARIBBEAN; *balteata* (Reeve, 1846); *densestriata* (C. B. Adams, 1850); *filosa* Rehder, 1943; *coxi* Fargo, 1953; *hemphilli* Bartsch & Rehder, 1939; GULF OF CALIFORNIA; *euryclea* (Dall, 1919). Pliocene; FLORIDA; *coxi* and *emeryi* Fargo, 1953. Miocene; JAMAICA; *eminula* Woodring, 1928.  
(See subgenera *Glabrocythara*, *Platycythara* and *Vitricythara*).

#### Subgenus GLABROCYTHARA Fargo, 1953, (of *Pyrgocythara*),

Monog. 8, Acad. Nat. Sci. Phil. p. 390. Type (o.d.) *Glabrocythara locklini* Fargo, 1953.

##### Plate 18, fig. 10

Shell small, 5.2 mm., very similar to *Pyrgocythara* in its adult facies but with a slightly different protoconch which is of  $2\frac{1}{2}$  - 3 whorls, broadly conical, tip small, partly immersed, the first  $1\frac{1}{2}$  whorls smooth and rounded, the next with fine closely spaced protractive riblets, the remainder with axials cancellated by spirals. Range — known only by the type species from the Pliocene of North St. Petersburg, Florida.

#### Subgenus PLATYCYTHARA Woodring, 1928 (of *Pyrgocythara*),

Carnegie Inst. Washington Publ. no. 385, p. 172. Type (o.d.) *Platycythara eurytoma* Woodring, 1928.

##### Plate 18, fig. 11

Shell small, 5.6 mm., narrowly fusiform, with a tall spire and narrow body-whorl, tapered gradually to a short weakly emarginate anterior canal, but the aperture is relatively wide, especially basally, where the varicose outer lip bears a slight stromboid notch. Protoconch stout, apically broad, of 2 -  $2\frac{1}{2}$  whorls, the last bearing fine closely spaced, protractive, curved axial riblets. Adult sculpture of closely spaced axial ribs overridden by strong spiral threads. The wide aperture, slight stromboid notch, and absence of labial denticles are the distinctive features. The genus *Adelocythara* is very similar but has fewer axials on the protoconch and a stout tubercle on the inside of the outer lip. Range — known only by the type species from the Miocene of Jamaica.

#### Subgenus VITRICYTHARA Fargo, 1953 (of *Pyrgocythara*),

Monog. no. 8 Acad. Nat. Sci. Phil., p. 395. Type (o.d.) *Cythara metria* Dall, 1903.

##### Plate 18, fig. 12

Shell small, 3.9-5.2 mm., elongately ovate-cylindrical, with a tall weakly turreted spire and a long body-whorl, slowly tapered to a short very shallowly notched anterior canal. Protoconch narrowly conical of 2-3 whorls, the last half whorl with transverse riblets. Outer lip thickened and margined on the inner side, with a well marked broad but rather shallow sinus, occupying the shoulder slope. Aperture long and rather narrow, without denticles.

Fargo compared his genus both with *Pyrgocythara* and with *Platycythara*, stating that in the former the axials on the protoconch begin much earlier, and that in the latter the protoconch is larger, the axial riblets more delicate and the aperture wider, with a definite stromboid curvature on the lower part of the outer lip. These appear to be very fine distinctions so it is recommended that both *Platycythara* and *Vitricythara* be reduced to subgenera of *Pyrgocythara*. Range — Recent and Pliocene of Florida.

#### CHARACTERISTIC SPECIES—

*metria* and subspecies *micromeris* Dall, 1903.

#### Genus THELECYTHARA Woodring, 1928,

Carnegie Inst. Washington Publ. no. 385, p. 173. Type (o.d.) *Cythara mucronata* Guppy, 1896.

##### Plate 18, fig. 17

Shell small, 5-6.5 mm., ovate-subpupoid, gradually contracted to a short slightly emarginate anterior canal. Protoconch erect, mammillary of  $1\frac{1}{2}$ - $3\frac{1}{2}$  smooth whorls. Aperture long and narrow; outer lip somewhat thickened; inner lip with a free edge, and a prominent parietal callus pad above. Sinus deep, on the shoulder slope, constricted by the parietal callus pad. Adult sculpture of narrow, closely spaced axials overridden by narrower spiral threads, and beaded at all points of intersection. Suture submargined by a heavy cord. Range — Miocene of Jamaica and the Dominican Republic. Pliocene of Florida.

#### CHARACTERISTIC SPECIES—

Miocene; *mucronata* (Guppy, 1896). Pliocene; *floridana* Fargo, 1953.

#### Genus EOCLATHURELLA Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, 5, p. 166. Type (s.d. Harris, 1937) *Eoclathurella jacksonica* Casey, 1904.

##### Plate 18, figs. 14, 15

Shell small, 5-6.2 mm., narrowly ovate-biconic, with gently rounded whorls, and an ovate body-whorl, ending in a short unnotched anterior canal. Protoconch relatively large, broadly conical of 3-4 closely coiled whorls, smooth except for the last whorl, which gradually acquires some longitudinal riblets as it

merges into the post embryonic sculpture. Adult whorls latticed by numerous narrow axial ribs crossed by spiral cords of almost equal strength. Sculpture slightly weaker over an ill defined shoulder slope. Aperture narrowly ovate. Outer lip with a distinct broadly rounded sinus which occupies most of the shoulder slope. Inner lip with a free-edged callus, bearing 3-4 transverse plicae at maturity. Range — Known only from the Jackson and Claiborne Eocene of Alabama and Louisiana.

CHARACTERISTIC SPECIES—

*jacksonica* Casey, 1904, *meridionalis* (Meyer, 1886), *obesula* Casey, 1904.

Genus PLEUROTOMOIDES Bronn, 1831,

Ergeb. nat. Reisen, 2, p. 555, nom. nov. pro *Defrancia* Millet, 1826 (non Bronn, 1825). Type (s.d. Dall, 1908) *Defrancia pagoda* Millet, 1826. (Note: Dall designated *pagoda* Millet, 1826, as type of both *Clathurella* and *Defrancia*, since the former was published as a nom. nov. pro *Defrancia*; see under *Clathurella* Carpenter, 1857).

Plate 18, figs. 18-20

Millett proposed *Defrancia* for five new species of *Glyphostoma*-like turrids — *pagoda*, *variabilis*, *hordeacea*, *suturalis* and *milletii*, which were from the Miocene of the Loire Basin, France. Millet's figure of *pagoda*, the subsequently designated type of the genus, is so stylized that recognition of the species is impossible without reference to type material. However, Glibert (1954, Inst. Roy. Sci. Nat. Belg. Mem. 129, pp. 56-58) has apparently done this, for he used the genus for four species and a subspecies, also from the Miocene of the Loire Basin, and including two species of Millet's original list. Further species were added in Glibert's 1960 paper (Inst. Roy. Sci. Nat. Belg. fasc. 64, pp. 86, 87), and others from the Miocene of Denmark and North Germany, were described or added by Sorgenfrei (1958, Dan. Geol. Unders, 2, no. 79, 1, p. 284).

I do not know of a subsequent authentic figure of *pagoda*, but judging from Glibert's (1954) figures of *strombillus* and *fascellinus* (Dujardin, 1837) and *hordaceous* and *milletii* (Millet, 1826), the shells are moderate sized, 10-20 mm., *Glyphostoma*-like but without apertural processes. The protoconch is paucispiral, of 2-2½ smooth whorls, with a strong submedian carina developing on the second whorl. Adult whorls more or less medially angulated, and sculptured with prominent axial folds, overridden by crisp spiral cords or threads. The outer lip has a thin crenulated edge but is strengthened behind by a heavy rounded varix. The sinus is subsutural, moderately deep, U-shaped, its upper edge drawn forward suturally to a moderate parietal callus pad. The anterior canal is short, slightly obliquely twisted and distinctly notched. Range — Miocene of the North Sea Basin, Loire Basin and Miocene-Pliocene of the Mediterranean Basin.

Glibert considered the genus to be daphnellid but neither the protoconch nor the sinus are in accord with that subfamily.

CHARACTERISTIC SPECIES—

*fascellina* (Dujardin, 1837), *hordeacea* (Millet, 1827), *luisae* (Koenen, 1872), *milletii* and *pagoda* (Millet, 1827), *perrisi* (Peyrot, 1932), *scalaria* (Cristofori & Jan, 1832), *simplex* Sorgenfrei, 1958, *strombillus* (Dujardin, 1837) and *subcostellata* (Orbigny, 1852).

Genus AUSTROPUSILLA Laseron, 1954, Handb. Roy. Zool. Soc. N.S.W. p. 25. Type (o.d.) *Mangelia hilum* Hedley, 1908.

Plate 18, fig. 25

Shell minute, 3.8-5.6 mm., thin, subcylindrical, with a long narrow body-whorl of almost two-thirds the shell height. Protoconch paucispiral, flattened on top and smooth. Aperture rather long and narrow, tapered to a very short, widely open and very shallowly notched anterior canal. Outer lip thin but with a deep U-shaped subsutural sinus. Adult sculpture of fine spiral threads, sometimes with the addition of a few faint axial plications. Colour of type species translucent amber, the apex purple tinged. Except for the very distinct and well formed sinus the genus resembles a slender columbellid. Range — Recent, New South Wales and Tasmania.

CHARACTERISTIC SPECIES—

*hilum* (Hedley, 1908) and *profundis* Laseron, 1954.

Genus PARAMONTANA Laseron, 1954, Handb. Roy. Zool. Soc. N.S.W. p. 41. Type (o.d.) *Clathurella modesta* Angas, 1877.

Plate 18, fig. 21

Shell small, 5-8 mm., cylindro-fusiform, with latticed adult sculpture of strong axial ribs, running from suture to suture and over the base to the anterior fasciole; overridden by equally strong rounded spiral cords. Protoconch of 1½ smooth whorls, the tip small and tilted, followed by a single large inflated whorl. Aperture rather narrow, with a very short weakly notched anterior canal. Outer lip heavily variced, with a shallowly excavated arcuate subsutural sinus, and rather strongly dentate within the outer lip. Colour white, light or yellowish-brown, sometimes with a band of chocolate on the base. The genus closely resembles *Kermia* in size, shape and style of adult sculpture, but that genus is a daphnellid, with a two whorled diagonally cancellated protoconch. Range — Recent, eastern Australia from north Queensland to New South Wales and Tasmania, also New Caledonia.

CHARACTERISTIC SPECIES—

*fusca* Laseron, 1954, *mayana* (Hedley, 1922), *modesta* (Angas, 1877), *oligoina* and *punicea* (Hedley, 1922), *rufozonata* (Angas, 1877).

Genus MAPPINGIA Ludbrook, 1941,

Trans. Roy. Soc. S. Aust. 65(1), p. 99. Type (o.d.) *Mappingia acutispira* Ludbrook, 1941.



## Plate 18, fig. 22

Shell small, 5.5-7.5 mm., *Guraleus*-like, elongate-subfusiform, with a tall spire and a relatively short, flexed, shallowly notched anterior canal. Protoconch of three elevated smooth whorls. Adult sculpture of very strong bluntly rounded axials, extending from suture to suture and over the base almost to the neck. The whole surface crossed by dense spiral lirae. Aperture narrow, elongate-pyriform; outer lip thin edged, slightly thickened behind, but conspicuously dentate within, and with a faint sub-sutural sinus. Despite the slight sinus it is doubtful if this genus is really turrid. Range — known only by two species from the lower mid Pliocene of South Australia.

## CHARACTERISTIC SPECIES—

*acutispira* Ludbrook, 1941; *matronalis* Ludbrook, 1958.

## Genus STEIRONEPION Pilsbry &amp; Lowe, 1932,

Proc. Acad. Nat. Sci. Phil. 84, p. 56. Type (o.d.) *Mangelia* (*Steironepion*) *melanosticta* Pilsbry & Lowe, 1932.

## Plate 18, fig. 24

Shell small, 4.4 mm., narrowly ovate-biconical, solid, with a tall spire but a truncated anterior end. Protoconch relatively large, conical of four smooth whorls, the last  $2\frac{1}{2}$  with a median carina. Adult sculpture of sharply raised narrowly rounded axials crossed by spirals of similar weight, giving a clathrate effect, with the rectangular interspaces slightly wider than high. Points of sculptural intersection gemmate. Aperture narrow, terminating in a short deeply notched anterior canal. Sinus subsutural, a broad shallow concavity, and without a fasciole. Outer lip thickened within and bearing four blunt denticles. Inner lip lightly callused but with a defined outer edge. Colour buff, sparsely sprinkled with dark-brown dots. Known only by the type species which is from San Juan del Sur, Nicaragua.

Except for the sinus and denticles within the outer lip, the genus resembles some of the smaller members of the Cerithiidae.

## Genus AMEKICYTHARA Eames, 1957,

Brit. Mus. (Nat. Hist.) Geol. Bull. 3(2), p. 52. Type (o.d.) *Cominella douvillei* Newton, 1922.

## Plate 18, fig. 23

This genus, represented by a moderate sized shell of about 20 mm. in height, is not very close to any other known genus but it does seem to exhibit some affinity with the eucitharid group of the Mangeliinae. Following is the original description.

"Of small-medium size, form resembling that of the *Cythara* group of the Turridae. Protoconch naticoid, consisting of two and a half smooth, convex whorls. Last whorl forming four-sevenths of the height of the shell. Spire conic, consisting of three to four gently

convex whorls which are moderately angulated at about two-thirds of their height; sutures linear. Ornament delicately cancellate, *Ficus*-like, with tiny crenulations at the intersections of the axial and spiral elements. Last whorl oval, gently angulated adapically like the spire whorls and similarly ornamented; base declivous and gently excavated at the origin of the moderately short neck; axial ornament obsolete and spiral ornament irregular abapically. Aperture narrowly oval, with a short siphonal canal which is gently inclined to the left and flares a little at its deeply emarginate end. Columella gently concave, with one prominent fold (well inside the aperture) at half the height of the aperture proper. Columellar lip with thin callus which is moderately widely spread adapically but narrow abapically. No siphonal fasciole. Imperforate. Outer lip thin at edge, moderately convex medially, slightly concave at a level corresponding with that of the columellar fold, receding adapically, and with a very shallow rounded sinus adjacent to the suture; thickened internally and with prominent, short lirae." Range — Known only by the type species from Bende Ameki, Eocene of Nigeria.

## Genus PROPEBELA Iredale, 1918,

Proc. Malac. Soc. 13, p. 32. Type (o.d.) *Murex turricula* Montagu, 1803). Syns. *Turritoma* Bartsch, 1941, Proc. Biol. Soc. Washington 54, p. 7 (non Ulrich & Scofield, 1897). *Turritomella* Bartsch, 1941, Nautilus 54 (4), p. 143 (nom. nov. for *Turritoma* Bartsch, 1941. Type (o.d.) *Turritoma exquisita* Bartsch, 1941.

## Plate 19, figs. 2, 3

Shell small to medium sized, 8-16 mm. narrowly biconic-fusiform, with a tall tabulated spire, and a long narrow body-whorl, slowly tapered to a short very shallowly notched anterior canal. Protoconch small, turbinat, of about  $2\frac{1}{2}$  whorls, tip small, smooth and flattened, next whorl smooth also, but becoming weakly subcarinate; final whorl conspicuously bicarinate, crossed by fine axial threads. Adult whorls tabulated by a flat almost horizontal shoulder. Strong vertical axial folds extend from the shoulder angle to the lower suture and over the body-whorl to the neck. The axials are also continued weakly over the shoulder slope to the upper suture. Spiral sculpture of closely spaced cords extends from the suture to the anterior end but these are usually much weaker on the shoulder slope. Aperture rather long and narrow; outer lip thin edged. Sinus a shallow concavity, its apex at about the middle of the shoulder slope. Operculum approaching vestigial, very narrowly ovate, subquadrate, with a terminal nucleus. Radula consisting of bundles of twisted rods.

Bartsch's *Turritomella* (= *Turritoma*) is not worth recognition since its only stated differentiating character is that the spiral cords are



supposed to be weaker over the shoulder slope as opposed to being evenly cordate over the whole shell in *Propebela*. Actually the strength of the shoulder spirals is variable, for some examples of *turricula* have an almost smooth shoulder. The periostracum is either exceedingly thin or absent. Range — Recent, circum-Arctic, off Japan in 167 fathoms, and off California in 580-870 fathoms, Pleistocene of England and Iceland, Pliocene of Japan.

#### CHARACTERISTIC SPECIES—

(typical) Recent; *nazanensis* (Dall, 1919), *nobilis* (Möller, 1842), *turricula* (Montagu, 1803) (= *mitrula* Lovén, 1846 = *robusta* S. V. Wood, 1872). Pleistocene; *turricula* (Montagu, 1803). Pliocene; JAPAN; *candida* (Yokoyama, 1926), *croisio* (Makiyama, 1927), *komakahida* (Otuka, 1949), *nipponensis* (Onoyama, 1938), *yokoyamai* Ozaki, 1958. ("Turritomella"), Recent — CALIFORNIA; *diomedea* and *smithi* (Bartsch, 1944); JAPAN; *exquisita* and *profundicola* (Bartsch, 1944).

#### Genus OENOPOTA Mörch, 1852,

Yoldi Cat. 1, p. 37. Type (s.d. Dall, 1919) *Fusus pleurotomarius* Couthouy, 1838.

##### Plate 19, fig. 1

Shell small to moderate sized, 10-23 mm., elongate-ovate, with a tall spire of rounded whorls, and a rounded body-whorl, tapered to a short spout-like canal, which is flattened at its extremity but scarcely emarginate. Protoconch narrowly papillate of about 2-2½ whorls, initially smooth, then developing three spiral cords, crossed by spaced axials, enclosing squarish interspaces. Adult sculpture of strong rounded slightly oblique axials, which extend from suture to suture and over most of the base, overridden by numerous spiral cords. Outer lip with a broad shallowly arcuate sub-sutural sinus. Periostracum thin, pale brownish. Radula (text figs. F149-152) consisting of a pair of marginals of the hilted dagger type, each with a conspicuous basal spur.

The genus resembles *Propebela* in general facies but lacks the shoulder and the attendant reduction of the axials over that area. Range — Recent, circum-Arctic to Japan and Alaska, the Pleistocene of California and the Pliocene and Miocene of Japan.

#### CHARACTERISTIC SPECIES—

Recent — *alaskensis* (Dall, 1871), *okudai* Habe, 1958, *pyramidale* (Ström, 1788) (= *pleurotomarius* Couthouy, 1838), *trevellianum* (Turton, 1834). Pleistocene — *turrispira* Berry, 1941. Pliocene — *kagana* (Yokoyama, 1927), *mortiei* Mac Neil, 1943, Miocene — *tayaensis* (Nomura & Hatai, 1939).

#### Subgenus FUNITOMA Bartsch, 1941 (of *Oenopota*),

Proc. Biol. Soc. Washington, 54, p. 5. Type (o.d.) *Funitoma areta* Bartsch, 1941. Syns. *Cestoma* Bartsch, 1941, Ibid. p. 5. Type (o.d.) *Funitoma* (*Cestoma*) *eurybia* Bartsch, 1941. *Granotoma* Bartsch, 1941, Ibid., p. 5. Type (o.d.) *Bela krausei* Dall, 1886.

##### Plate 19, figs. 4, 7, 11

The above three generic or subgeneric names of Bartsch are here grouped together

as one, since there is insufficient evidence at present to warrant their separate recognition. They are all small shells, 6-9 mm., of elongate-oval shape, with the spire and aperture height subequal. Protoconch paucispiral, sculptured with spiral cords (*Granotoma*). Adult sculpture of numerous axials which are distinctly flexed over the weak shoulder slope. Subsidiary sculpture of weak spiral cords, or deeply incised spiral lines in the case of *Granotoma*. Radula (*albrechti*; text fig. F153), a pair of hilted-dagger type, slender and curved marginals, with a conspicuous basal spur. For the present this group would appear to be more naturally placed as a subgenus of *Oenopota*. Range — Recent, Japan, Alaska and Washington and the Pliocene of Japan.

#### CHARACTERISTIC SPECIES—

(typical), Recent — *areta* Bartsch, 1941. Pliocene — *ozawai* (Yokoyama, 1926). ("Cestoma"), Recent — *eurybia* Bartsch, 1941. ("Granotoma"), Recent — *excurvata* (Carpenter, 1864), *krausei* (Dall, 1886); Pliocene — *dissoluta* (Yokoyama, 1926), and subsp. *gosenensis* Itoigawa, 1958.

#### Genus OBESOTOMA Bartsch, 1941,

Proc. Biol. Soc. Washington 54, p. 4. Type (o.d.) *Obesotoma japonica* Bartsch, 1941.

##### Plate 19, fig. 13

Shell relatively large, 13.2-25 mm., rather solid, ovoid with inflated non-shouldered whorls, and a thick periostracum. Protoconch almost invariably eroded but indicated as small, smooth and paucispiral. Adult sculpture mainly of dense microscopic lirae to moderately strong cords, and a secondary sculpture of fine incremental lines to moderate axial folds. Operculum corneous, claw-like, with a terminal nucleus (*japonica*). Radula of hilted dagger type marginals, the basal part corresponding to the hilt (*japonica*); figured example of radula (*lawrenciana* Dall, 1919; text fig. F154). Range — circum-Arctic to Alaska and Japan.

#### CHARACTERISTIC SPECIES—

*arctica* (A. Adams, 1855), *hanazakiensis* Habe, 1958, *japonica* Bartsch, 1941, *lawrenciana* (Dall, 1919), *murdochiana* (Dall, 1885), *schantaricum* (Middendorff, 1849), *uchidai* Habe, 1958.

#### Genus NODOTOMA Bartsch, 1941,

Proc. Biol. Soc. Washington 54, p. 5. Type (o.d.) *Pleurotoma* (*Bela*) *impressa* (Beck) Mörch, 1869. Syns. *Canetoma* Bartsch, 1941, Ibid. p. 6. Type (o.d.) *Canetoma tersa* Bartsch, 1941. *Curtitoma* Bartsch, 1941, Ibid. p. 6. Type (o.d.) *Curtitoma hecuba* Bartsch, 1941. *Nematoma* Bartsch, 1941, Ibid. p. 6. Type (o.d.) *Nematoma hokkaidoensis* Bartsch, 1941. *Venustoma* Bartsch, 1941, Ibid., p. 6. Type (o.d.) *Venustoma harucoa* Bartsch, 1941.

##### Plate 19, figs. 5, 6, & 8-10

The above five generic or subgeneric names of Bartsch are here grouped together as one since there is insufficient evidence at present to warrant separate recognition. The radula is not known in any one of the five, the proto-



conch is described in but one of them, *Venustoma*, and all more or less conform to a type, in that they are small, ovate-biconical, with the spire and aperture subequal in height, and sculptured with combinations of axials and spirals, sometimes one element dominant, sometimes the other, and occasionally both more or less equal, resulting in fenestration. The sinus is a very slight subsutural insinuation in all the groups. Range — Recent, circum-Arctic to Japan and Pliocene and Miocene of Japan. Shell small, 4.8-15 mm.

CHARACTERISTIC SPECIES—

(typical); Recent—*impressa* (Mörch, 1869). ("*Cane-toma*"); *tersa* Bartsch, 1941. ("*Curtitoma*"); Recent — *hecuba* Bartsch, 1941; Miocene — *totomiensis* (Makiyama, 1931), *kurodai* (Onoyama, 1938). ("*Nematoma*"); Recent — *hokkaidoensis* Bartsch, 1941; Pliocene — *exquisita* (Yokoyama, 1926), *tomiyaensis* (Otuka, 1949) and subsp. *iioakaensis* Ozaki, 1958. ("*Venustoma*"), Recent — *harucoa* Bartsch, 1941.

Genus BELALORA Powell, 1951,

Discovery Repts. 26, p. 171. Type (o.d.) *Belalora thielei* Powell, 1951.

Plate 19, fig. 12

Shell small, 4.25-7 mm., ovate-biconic, rather thin, but prominently sculptured with fold-like obliquely arcuate axials, overridden by dense spiral lirations. Protoconch proportionately large, dome-shaped, of three whorls, tip smooth and planorbid, followed by a whorl of closely spaced spiral threads, and finally a whorl of spiral cords crossed by axial threads. Shoulder sulcus rather narrow; the axials are considerably reduced over the shoulder area but suddenly gain their maximum strength at its lower edge. Aperture narrowly ovate-pyriform, terminating in a short spout-like anterior canal. Sinus deeply concave, occupying the shoulder area. Inner lip smooth, with a broad columellar callus. Operculum vestigial, ovate, with a terminal nucleus.

The genus resembles *Propebela* in build and in adult sculpture but is more broadly biconic and has a deeply concave sinus; that of *Propebela* is so shallow that it is scarcely apparent. Range — Antarctic and subantarctic; off Falkland Islands, and the Davis Sea; 110-219 metres.

CHARACTERISTIC SPECIES—

FALKLANDS; *thielei* Powell, 1951. ANTARCTICA; *striatula* (Thiele, 1912).

Genus LORABELA Powell, 1951,

Discovery Repts. 26, p. 171. Type (o.d.) *Bela pelsenieri* Strebel, 1908.

Plate 19, fig. 14

Shell small, 5.7-8.2 mm., ovate-biconic, with shouldered whorls, rather thin but strongly sculptured with rather distant narrow flexuous axials, and weaker spiral sculpture, which overrides the axials. Protoconch narrowly papillate of 1½ smooth whorls, followed by a

few brephic axials. Aperture ovate-pyriform, produced below into a short spout-like anterior canal. Outer lip thin but with a deep rounded sinus, occupying the shoulder. Operculum vestigial, thin, oval, with a terminal nucleus. Radula very similar to that of *Propebela turricula* (Montagu), which consists of bundles of slender twisted rods. Range — South Georgia and Antarctica, 155-351 metres.

This genus and *Belalora* show relationship to the Boreal *Propebela* but differ mainly in having a much deeper and more distinctive sinus. From each other the southern genera are readily distinguished by their respective protoconchs.

CHARACTERISTIC SPECIES—

SOUTH GEORGIA; *bathybia*, *notophila* and *pelsenieri* (Strebel, 1908). ANTARCTICA; *davisi* (Hedley, 1916) and *plicatula* (Thiele, 1912).

Genus CONORBELA Powell, 1951,

Discovery Repts. 26, p. 170. Type (o.d.) *Bela antarctica* Strebel, 1908.

Plate 19, fig. 15

Shell moderately large, 20-29 mm., thin, ovate-biconic, with a prominent flat gently sloping shoulder slope, defined by a narrowly rounded ridge-margined keel, at above middle whorl height. The protoconch, so far as can be judged from the eroded available material, is large, dome-shaped and paucispiral. Adult sculpture of very weak spiral lirae, covered by a very thin pale buff periostracum. Body-whorl capacious, broadly ovate, gradually narrowed below to an undifferentiated broad spout-like anterior canal. Columella slightly twisted towards its termination, but without plaits or folds. Sinus broad, a very shallow concavity, occupying the whole of the shoulder slope. The operculum is irregularly ovate, with a terminal nucleus, vestigial, occupying less than a third of the linear dimensions of the aperture. No radula was located. Range — Antarctic, south-west of Snow Hill Island, Clarence Island and South Sandwich Islands, 125-342 metres.

The genus has a superficial resemblance to the cancellarid *Admete* but lacks the characteristic pillar plaits of that family.

Subfamily DAPHNELLINAE Hedley, 1922

Shells ranging from the smallest of the turrids, 1.5 mm. in height (*Zenepos*), to the giant *Pontiothauma mirabile*, of 136 mm. (over five inches).

The following characters, in varying combinations, signify the Daphnellinae — i.e. — a protoconch of the diagonally cancellated sinuigerid type — a sutural sinus that descends vertically and then is produced tangentially forward, like a reversed letter L — a radula, usually of awl-shaped marginals, with the tip laterally constricted, so that it resembles a candle-flame — the operculum absent, except

for *Typhlodaphne* and *Pontiothauma*, in which it is vestigial, and finally, the occasional presence of weak oblique pillar folds or plications.

The diagonally cancellated protoconch is found also in the closely allied Thatcheriinae, but in no other turrid subfamily. The reversed L-shaped sutural sinus is more or less restricted to the Daphnellinae; only the Conorbinae have a somewhat similar sinus. The protoconch varies from tall, diagonally cancellated, polygyrate to paucispiral and almost smooth, and the reversed L-sinus is sometimes rendered U-shaped to subtubular, when restricted above by a parietal tubercle.

The Daphnellids are very numerous in both genera and species, and have a world-wide distribution, ranging in time back to the Eocene, but the greatest development is late Tertiary and Recent.

#### Genus DAPHNELLA Hinds, 1844,

Zool. Sulphur Moll. p. 25. Type (s.d. Herrmannsen, 1847) *Pleurotoma lymneiformis* Kiener, 1839-40. Syns. *Eudaphne* Bartsch, 1931, Proc. U.S. Nat. Mus. 79, p. 3 (non Reuss, 1922). Type (o.d.) *Eudaphne allemani* Bartsch, 1931. *Eudaphnella* Bartsch, 1933, Nautilus, 47, p. 76 (nom. nov. for *Eudaphne* Bartsch, 1931). *Paradaphne* Laseron, 1954, Handb. Roy. Zool. Soc. N.S.W. p. 44. Type (o.d.) *Daphnella botanica* Hedley, 1918.

#### Plate 19, fig. 16

Shell of moderate size, 10-30 mm., elongate-ovate, with a long body-whorl, slowly contracted to a short unnotched spout-like anterior canal. Body-whorl usually more than half the shell height. Protoconch polygyrate and diagonally cancellated. Sinus moderate, sutural, reversed L-shaped. Adult sculpture delicately and densely spirally lirate, usually reticulated by equally fine and dense axial lirae. Frequently irregularly maculated with reddish-brown.

Radula (text figs. F158-160), a pair of slender awl-shaped marginals, constricted near the end, so that the point resembles a candle flame.

Laseron proposed *Paradaphne* without stating any differentiating characters from *Daphnella*. He claimed that in such a widespread and ancient group that the Australian members were a parallel development not necessarily related to typical *lymneiformis*. I can find no characters of differentiation for *Paradaphne* and similarly Bartsch's tropical West American *Eudaphnella* is indistinguishable from *Daphnella*. Range — Recent, Indo-Pacific, Philippines, Japan, Australia, New Zealand, New Caledonia, Hawaii, Caribbean and tropical West America; Pliocene, Okinawa; Miocene, Victoria and Eocene of the south-eastern United States. Also recorded from Florida, Azores, Patagonia and South Africa, Pliocene of Florida, Oligocene to Pliocene of Europe and Eocene of Peru, but many of the

species will require to be checked. By far the greater number of species now live in the Indo-Pacific.

#### CHARACTERISTIC SPECIES—

Recent — INDO-PACIFIC; "*angulata*" (Kuroda ms.) Oyama & Takemura, 1958 (non Peyrot, 1938); *atractoides* Hervier, 1897; *aulacoessa* (Watson, 1881); *aureola* (Reeve, 1845); *boholensis* (Reeve, 1843); *botanica* Hedley, 1918; *bucklandi* (Laseron, 1954); *celebensis* Schepman, 1913; *compsa* (Watson, 1881); *delicata* (Reeve, 1846); *elegantissima* Schepman, 1913; *flammea* Hinds, 1843; *hyalina* (Reeve, 1845); *itonis* (Kuroda ms.) Oyama & Takemura, 1958; *marmorata* Hinds, 1844 (= *daphnelloides* Reeve, 1845); *mitrellaeformis* Nomura, 1940; *nobilis* (Kuroda ms.) Kira, 1954; *ornata* Hinds, 1844; *patula* (Reeve, 1845); *proxima* (Kuroda ms.) Oyama & Takemura, 1958; *pernobilis* (Kuroda ms.) Kuroda & Habe, 1961; *perfragilis* Schepman, 1913; *semivaricosa* (Kuroda ms.) Oyama & Takemura, 1958; *sandwicensis* Pease, 1860; *teramachii* (Kuroda ms.) Oyama & Takemura, 1958. NEW ZEALAND, *cancellata* Hutton, 1878. TROPICAL WEST AMERICA, *allemani* (Bartsch, 1918); *bartschi* Dall, 1919; *casta* Hinds, 1844; *concinna* (C. B. Adams, 1852); *mazatlanica* Pilsbry & Lowe, 1932; *panamica* Pilsbry & Lowe, 1932; *sinuata* (Carpenter, 1856). CARIBBEAN, *lymneiformis* (Kiener, 1839-40) (= *decorata* C. B. Adams, 1850); *morra* (Dall, 1881); *reticulosa* Dall, 1889. Pliocene — OKINAWA, *ryukyuensis* Mac Neil 1960. FLORIDA, *cingulata* Dall, 1890. Miocene — VICTORIA, *cuspidatus* (Chapple, 1934). Eocene — S.E. UNITED STATES, *imperita* and *quindecima* Harris, 1937.

#### Subgenus DIAUGASMA Melvill, 1917, (of *Daphnella*),

Proc. Malac. Soc. 12, p. 195. Type (o.d.) *Daphnella epicharta* Melvill & Standen, 1903.

#### Plate 19, fig. 17

Shell very small, 5-11 mm., oliviform, smooth, or microscopically spirally striated, mainly on each side of the sutures, leaving the middle of the whorls plain. Protoconch of 3 delicately diagonally cancellated whorls. Spire whorls almost flat-sided; body-whorl long, narrowly cylindrical, gradually tapered to a short very weakly emarginate anterior canal. Aperture long, narrowly ovate, with a thin outer lip and a very weak, almost obsolete sutural sinus. Colour semi-pellucid white, flecked with pale straw colour.

Melvill included in his subgenus, *olyra* and *vitrea* both of Reeve, 1845, but only the first-mentioned resembles *epicharta*. The second species, *vitrea*, has a well formed subsutural sinus, so does not appear to belong in *Diaugasma*. Range — The type species is from the Gulf of Oman in 156 fathoms; *olyra* is from unknown locality.

#### CHARACTERISTIC SPECIES—

*epicharta* Melvill & Standen, 1903, *olyra* (Reeve, 1845).

#### Subgenus HEMIDAPHNE Hedley, 1918 (of *Daphnella*),

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Pleurotoma souverbiei* Smith, 1882.

#### Plate 19, fig. 18

Shell of small to moderate size, 7-25 mm., distinguished from *Daphnella* by its more cylin-



drical form, and solid shell, usually with widely spaced strong axials on the early post-nuclear whorls, while the remaining adult whorls are comparatively smooth. The outer lip is weakly variced and dentate at its thin outer edge. The sinus is approximately reversed L-shaped, but does not descend straight down from the suture but is curved forwards slightly above, so that it is broadly shallowly rounded at its apex, not straight. The protoconch (*axis* Reeve) is of about  $3\frac{1}{2}$  whorls, tip smooth, following whorl finely spirally granulate-lirate, then with protractively arcuate fine protractive riblets, diagonally cancellated over the lower half of the whorls only. The type species is pure white, *reeveana* has the addition of brown spiral lines, and *axis* is faintly maculated. Range — Recent, Indo-Pacific; Madagascar, Persian Gulf, Philippines, Western Australia, New Caledonia and Tuamotu Archipelago.

CHARACTERISTIC SPECIES—

*axis* (Reeve, 1846); *cyclophora* (Deshayes, 1863); *lirata* (Reeve, 1845); *reeveana* (Deshayes, 1863); *rissoides* (Reeve, 1843); *souverbiei* (Smith, 1882); *subula* (Reeve, 1845); *subuloides* (Schepman, 1913); *supracancellata* (Schepman, 1913).

Genus AUSTRODAPHNELLA Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W., p. 45. Type (o.d.) *Austrodaphnella clathrata* Laseron, 1954.

Plate 19, fig. 20

Shell small, 10 mm., like *Daphnella* but elongate-fusiform, with the anterior end produced into a long straight unnotched anterior canal. Protoconch polygyrate and diagonally cancellated. Adult sculpture of prominent axial ribs, overridden by strong distant spiral cords. Sinus subsutural, slight. *Daphnella* has a similar protoconch and sinus but the shell shape is elongate-ovate and the adult sculpture a dense fine reticulation. Range — known only by the type species, Recent from New South Wales.

Genus TASMADAPHNE Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W., p. 46. Type (o.d.) *Tasmadaphne spicula* Laseron, 1954.

Plate 19, fig. 19

Shell small, 8-10 mm., ovate-fusiform; like *Daphnella*, but with coarse clathrate sculpture of strong axials, crossed by narrow but sharply raised spirals, and with a very different protoconch. Sinus subsutural, deep. Protoconch smooth, paucispiral, acuminate, consisting of a small oblique tip, followed by an inflated globe whorl. Range — Recent, New South Wales, Australia.

CHARACTERISTIC SPECIES—

*aculeola* (Hedley, 1915); *spicula* Laseron, 1954.

Genus HOKIANGA Laws, 1947,

Trans. Roy. Soc. N.Z. 76, p. 540. Type (o.d.) *Hokianga nodulata* Laws, 1947.

Plate 19, fig. 21

Shell small, 9.3 mm., biconic but with the turreted spire about  $1\frac{1}{2}$  times the height of the aperture. Protoconch narrowly conical of 3-4 diagonally cancellated whorls. Sinus sutural, moderately deep, of typical reversed-L type. Whorls with a sharp peripheral carina, and adult sculpture of sharply raised axials, overridden by narrow sharp spiral cords, the points of intersection nodular to spinose. Range — Known only by the type species which is from the Otaian Oligocene of Hokianga, New Zealand.

In most respects the genus resembles *Tasmadaphne*, except for the protoconch of the latter, which is not reticulated, but small and acuminate of three small whorls. Other superficially similar genera are *Puha* and *Maori-daphne*, but in both of these the sinus is very weak, a faint sutural excavation at most.

Genus FUSIDAPHNE Laseron, 1954,

Roy. Zool. Soc. N.S.W. Handb., p. 47. Type (o.d.) *Fusidaphne bullata* Laseron, 1954.

Plate 20, fig. 1

Shell small, 9 mm., fusiform, with a moderately tall spire, rather inflated whorls, a deeply excavated base and truncated anterior end. Protoconch paucispiral, consisting of a minute smooth globular tip followed by  $1\frac{1}{2}$  whorls bearing strong spiral threads, between which are microscopic axial threads, the whole protoconch terminated by a sharply raised arcuate varix. Adult sculpture of narrowly crested but prominent regular axial ribs, overridden by strong spiral cords, which form sharp tubercles at the points of intersection, and combine to divide the surface into rectangular pits. Aperture short and wide. Outer lip thin, with a shallow sutural sinus. Neck and anterior end straight, sculptured with closely spaced smooth spiral cords. Anterior canal short and rather widely open. Colour uniformly pale yellow. Range — Known only by the type species which is from 10-15 fathoms off Twofold Bay, southern New South Wales, Australia.

Apart from its distinctive protoconch, *Fusidaphne* most closely resembles *Tasmadaphne* in its adult facies.

Genus RIMOSODAPHNELLA Cossmann, 1915,

Essais Pal. Comp. 10, p. 229. Type (o.d.) *Murex textilis* Brocchi, 1814. (sic "*Rimosodalphnella*," p. 229).

Plate 20, figs. 2, 3

Shell of moderate size, ca 16 mm., with a tall spire of strongly convex whorls but a short body-whorl, quickly contracted to a relatively long, flexed, unnotched anterior canal. Sculpture, a dense reticulation of numerous narrow axials, overridden by numerous narrow spiral cords. Sinus deep, reversed L-shape at its in-



ception, then produced forward into the great swinging arc of the thin-edged outer lip. Range — The Pliocene of northern Italy.

The genus is close to typical *Daphnella*, differing mainly in its tall spire of strongly convex whorls, short body-whorl, and the great forward swing of the outer lip. In typical *Daphnella* the general shape is narrowly ovate rather than fusiform, the spire is short, and the body-whorl long and very gradually tapered. The shape and general facies of *Rimosodaphnella* resembles those of *Asperdaphne* but in that genus the sinus is very slight.

CHARACTERISTIC SPECIES—

*cipriani* (Hornung, 1920), *salinasi* (Calcare, 1841) and *textile* (Brocchi, 1814).

Genus FAVRIELLA Hornung, 1920,

Ann. Mus. Stor. nat. Genova, 3, 9, p. 76. Type (monotypy) *Daphnella* (*Favriella*) *weberi* Hornung, 1920.

Plate 20, fig. 4

Shell small, 8.5 mm., rather broadly fusiform, with a tall tabulated spire, sharply angled above middle whorl height, and a short sharply angulate body-whorl, deeply contracted basally and over the neck, terminated in a relatively long, flexed, unnotched anterior canal. Protoconch tall, narrowly conical of four diagonally cancellated whorls. Adult sculpture of rather distant strong but narrowly crested vertical axials, which are weak over the shoulder sulcus, and strongest at the periphery, where they are vertically compressed to almost spinose. The whole surface is overridden by weak spiral cords. Sinus described as sutural, but with no indication of its depth; nor do the illustrations help in this respect.

The author considered his genus to occupy a position between *Teretia* and *Rimosodaphnella*. The former is characterised by a polygyrate diagonally cancellated protoconch, a deep reversed L-shaped sinus and prominent spiral sculpture. Both *Rimosodaphnella* and *Favriella* are alike in having predominantly axial sculpture, but the former has a deep sutural sinus and a conoidal protoconch of three whorls, the first smooth and the remainder diagonally cancellated. However, judging from descriptions and figures alone, there seems to be no significant differences between *Favriella* and *Metuonella* Sorgenfrei, 1958, which was based upon the North German Miocene *Daphnella grippi* Kautsky, 1925. Range — The type species is from the lower Pliocene of Liguria, Italy, and if *Metuonella* is admitted as a synonym, the range would include the Miocene of North Germany and Denmark as well.

Genus METUONELLA Sorgenfrei, 1958,

Geol. Surv. Denmark, ser. 2, no. 79, p. 293. Type (o.d.) *Daphnella grippi* Kautsky, 1925.

Plate 20, fig. 5

Shell small, 5.1 mm., elongately ovate-fusiform, with the spire taller than the aperture, which includes a moderately long flexed unnotched anterior canal. Adult sculpture of prominent rather widely spaced angulate axials, overridden by granular to squamose spiral cords and threads. Sinus indicated as subsutural and shallow. Protoconch a polygyrate sinu-sigera, but not simply diagonally cancellated; the axial threads curve from suture to suture, but diagonal threads which cancellate the axials over the lower two-thirds of the whorls, change direction towards the upper suture, where they become spiral, parallel to the upper suture. Range — the type species is from the Miocene, Hemmoor Stage in Germany and Denmark.

The genus appears to be closely allied to, if not identical with *Favriella* Hornung, 1920, from the lower Pliocene of Liguria, Italy.

Genus RAPHITOMA Bellardi, 1848,

Mem. R. Accad. Sci. Torino, 2, 9, pp. 538, 612. Type (s.d. Monterosato, 1875, Bull. Soc. Malac. Italiana 1, p. 72) *Pleurotoma hystrix* Cristofori & Jan, 1832.

Plate 20, figs. 6, 7

This genus has been subject to several widely dissimilar interpretations, due largely to conflicting opinions regarding the type species. Woodring (1928, Carnegie Inst. Wash. Publ. no. 385, p. 179) claimed that Monterosato's designation was the earliest valid one, and that Bellardi's (1878) statement that one may regard *Raphitoma vulpecula* (Brocchi) as the typical form of the genus, cannot be considered as a type designation. Cossmann (1896, Ess. Pal. Comp. 2, p. 131) added to the confusion by citing *Pleurotoma plicatella* Jan, as neotype of the genus.

Regarding the legitimate designation of *hystrix*, by Monterosato, there is a further complication since Sykes (1906, Proc. Malac. Soc. 7, p. 187) claimed that in the Italian Pliocene typical *hystrix*, the protoconch is composed of 3-4 whorls, while in the Recent shell, which he named *pseudohystrix*, the protoconch resembles that of *Trophon*, i.e. paucispiral and globular. I have no apices of true *hystrix* so am unable to state to what extent they differ from that of *pseudohystrix*, which is peg-like of 2½ loosely wound convex whorls, the tip blunt, asymmetrical and inrolled, the whole microscopically sculptured with obscure spiral malleations.

The genus resembles *Veprecula* in its clathrate sculpture, but the spinose development at the intersection of the sculptural elements is much more prominent, the sinus is broader but relatively shallower and the anterior canal shorter and straighter. Range — Recent, Mediterranean to Madeira and Pliocene of England, France and Italy.



## CHARACTERISTIC SPECIES—

Pliocene — *hystrix* (Cristofori & Jan, 1832). Recent — *pseudohystrix* Sykes, 1906.

For the present only two species are admitted, and one of these provisionally, until their respective protoconchs are compared.

## Genus OTITOMA Jousseume, 1898,

Le Naturaliste, 2, 12, p. 106. Type (tautonymy) *Otitoma otitoma* Jousseume, 1898 (sic for *otitoma*?).

This unfigured species, which is a Recent shell from the Red Sea, is unknown to me. Wenz (1943, Handb. der Pal., 6, p. 1452) placed it in the synonymy of *Raphitoma*.

## Genus VEPRECULA Melvill, 1917,

Proc. Malac. Soc. 12, p. 190. Type (o.d.) *Clathurella sykesii* Melvill & Standen, 1903. Syn. *Mordica* Dall, 1924, Proc. Biol. Soc. Washington 37, p.88. Type (o.d.) *Mordica brunonia* Dall, 1924.

## Plate 20, fig. 8

Shell small, 3-10 mm., narrowly fusiform, with a tall spire of rounded rapidly increasing whorls, and a long narrow slightly flexed unnotched anterior canal. Protoconch tall, narrowly conical of 4-5 whorls, the tip smooth, the remainder with numerous thin axials, sometimes with subsidiary interstitial microscopic spiral threads; not diagonally cancellated as in *Daphnella*. Adult whorls fenestrated by thin axials crossed by sharp spiral cords of equal strength, spinose at the points of intersection. Sinus a very deep narrow sutural cleft. Colour pure white, buff or brownish. Range — Recent, Indo-Pacific, Zanzibar, Persian Gulf, Japan, Hawaiian Islands, North Queensland, New South Wales and New Zealand, 5-230 fathoms.

The South Australian *?Veprecula adalaidensis* Powell, 1944, is excluded from the genus, since both the protoconch and the sinus are atypical; the former is diagonally cancellated as in *Daphnella*, and the latter is shallower than in *Veprecula*, but deeper than in *Asperdaphne*. The Recent Japanese *aesara* Dall, 1918 (= *asperulata* Smith, 1882) is excluded also, since its protoconch is described as of 2½ smooth whorls.

## CHARACTERISTIC SPECIES—

*arethusia* (Dall, 1918) (= *reticulosa* Smith, 1882), *brunonia* (Dall, 1924), *cooperi* Mestayer, 1919, *echinulata* (Thiele, 1925), *hedleyi* (Melvill, 1904), *scala* Hedley, 1922, *sykesii* (Melvill & Standen, 1903), *vacillata* and subsp. *paucicostata* Hedley, 1922, *vepratrica* (Hedley, 1903).

## Genus TERETIA Monterosato, 1890,

Nat. Sicil. 9, p. 187 Nom. nov. for *Teres* Bucquoy, Dautzenberg and Dollfus, 1883, Moll. Mar. Roussillon 1, p. 85 (non Boettger, 1878). Type (o.d.) *Pleurotoma anceps* Eichwald, 1830.

## Plate 20, fig. 9

Shell small, 8-15 mm., elongate-fusiform with a tall spire and a long unnotched anterior canal; thin and fragile, resembling *Veprecula*,

but with only spiral sculpture of a few smooth prominent keels. Protoconch tall, narrowly conic, of four diagonally cancellated whorls. Sinus sutural, occupying the entire shoulder slope, deep, of reversed L-shape, apex straight, vertically descending. Range — Recent, Norway to the Mediterranean and Canary Islands. Pliocene of Italy and Miocene of the Vienna Basin.

## CHARACTERISTIC SPECIES—

Recent — *amoena* (G. O. Sars, 1878); *anceps* (Eichwald, 1830); *megalembryon* (Dautzenberg & Fischer, 1896). Pliocene — *nana* Hornung, 1920. Miocene — *anceps* (Eichwald, 1830) (= *barbieri* Brusina, 1866 = *boreale* Loven, 1846 = *fusiforme* Reuquien, 1848 = *la viae* Calcare, 1845 = *minutum* Aradas, 1847 = *anceps soluta* Marshall, 1912 = *teres* (Forbes) Reeve, 1844 = *trecchi* (Testa) Jeffreys, 1867.

## Genus NEPOTILLA Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Daphnella bathentoma* Verco, 1909.

## Plate 20, fig. 10

Shell very small, 1.5-6 mm., fusiform-biconic, angulate at the periphery, and strongly sculptured with sharply raised spiral keels, usually crossed by rather distant lamellate axials, producing a coarse reticulation. Protoconch paucispiral of 1½ whorls, tip smooth, oblique, acuminate, followed by a cylindrical spirally lirated whorl. A feature of the genus is the exceedingly deep, slit-like sutural sinus. Some of the species listed below (i.e. *triseriata* Verco and *carinata* Laseron) have an adult sculpture of spirals only, which suggests the genus *Zenepos* rather than *Nepotilla*. However, both these species have the deep sinus of *Nepotilla*; that of *Zenepos* is very slight. Range — Recent; South Australia, Victoria, Tasmania, New South Wales, Queensland and New Zealand. Pliocene; South Australia. Oligocene; New Zealand.

## CHARACTERISTIC SPECIES—

Recent — Australia; *aculeata* (May, 1915); *bathentoma* (Verco, 1909); *carinata* Laseron, 1954; *diaphana* May, 1919; *excavata* (Gatliff, 1906); *fenestrata* (Verco, 1909); *lamellosa* (Sowerby, 1896); *microscopica* (May, 1915); *serrata* Laseron, 1954; *triseriata* (Verco, 1909); *tropicalis* Hedley, 1922. NEW ZEALAND; *finlayi* Powell, 1937; *nitidula* Powell, 1940; *powelli* Dell, 1956; *vera* Powell, 1940. Pliocene — SOUTH AUSTRALIA; "powelli" Ludbrook, 1958 (non Dell, 1956). Oligocene — NEW ZEALAND; *bartrumi* Laws, 1939.

## Genus MICROGENIA Laseron, 1954,

Handb. Roy. Zool. Soc. N.S.W., p. 50. Type (o.d.) *Clathurella edwini* Brazier, 1894.

## Plate 20, figs. 11, 12

Shell very small, 3.5 mm., fusiform-biconic, sculptured with moderately strong spiral cords. The genus is superficially similar to both *Nepotilla* and *Zenepos* but differs in two important respects. Firstly the protoconch, although paucispiral and similar in shape to that of *Nepotilla*, is diagonally cancellated, not spirally

lirate, and secondly, the sinus, although deep as in *Nepotilla* is not slit-like, as in that genus, but is widely open, since the lower margin descends rather steeply and becomes gradually confluent with the forwardly arcuately produced outer lip. Range — known only by the type species, which is from Port Jackson, New South Wales, Australia.

#### Genus STILLA Finlay, 1926,

Trans. N.Z. Inst. 56, p. 254. Type (o.d.) *Mangilia flexicostata* Suter, 1899.

##### Plate 20, fig. 13

Shell minute, 1.6-2.25 mm., biconical to shortly fusiform, with simple straight to slightly flexed axials; the spiral sculpture mostly sparse and weak, absent from the anterior end. Protoconch subglobose, paucispiral and densely spirally lirate. Sinus subsutural, shallow. Both *Nepotilla* and *Veprecula* have an extremely deep sinus and clathrate sculpture, while *Zenepos* has spiral cord sculpture only, and an even shallower sinus than *Stilla*. Range — Recent, New Zealand, 15-170 fathoms, mostly from the subantarctic waters of the Antipodean and Forsterian Provinces.

#### CHARACTERISTIC SPECIES—

*anomala* Powell, 1955; *delicatula* Powell, 1927; *fiordlandica* Fleming, 1948; *flexicostata* (Suter, 1899) and *paucicostata* Powell, 1937.

#### Genus ZENEPOS Finlay, 1928,

Trans. N.Z. Inst. 59, p. 250. Type (o.d.) *Daphnella totolirata* Suter, 1908.

##### Plate 20, fig. 14

Shell very small, 1.7-7 mm., similar to *Nepotilla*, but more slender and sculptured with numerous spiral cords, rather than keels, and without axials other than growth lines. Protoconch paucispiral, spirally lirate, of  $1\frac{1}{2}$  whorls, as in *Nepotilla*, but with a less exerted tip. From both *Nepotilla* and *Stilla* the genus is easily distinguished by its extremely shallow, almost imperceptible subsutural sinus. Range — Recent; New Zealand, Tasmania, South Australia and probably South Africa. Pleistocene; New Zealand.

#### CHARACTERISTIC SPECIES—

Recent; NEW ZEALAND — *chariessa* (Suter, 1908); *totolirata* (Suter, 1908). AUSTRALIA — *mimica* (Sowerby, 1896); *minuta* (Tenison-Woods, 1877). SOUTH AFRICA — *miranda* (Thiele, 1925). Pleistocene; NEW ZEALAND — *lacunosa* (Hutton, 1885).

#### Genus CRYPTODAPHNE Powell, 1942,

Bull. no. 2, Auck. Inst. Mus., p. 164. Type (o.d.) *Cryptodaphne pseudodrillia* Powell, 1942.

##### Plate 20, fig. 17

Shell small, 6-10 mm., with a superficial resemblance to the Clavinae, resultant from the keeled whorls and pagodiform spire. The type species has much the appearance of a *Tomopleura*, but is at once distinguished by

the daphnellid characteristics of both a polygyrate diagonally cancellated protoconch, and a distinct reversed L-shaped sinus. Range — Otaian, upper Oligocene of New Zealand and Recent, East Indies in deep water, 400-835 metres.

#### CHARACTERISTIC SPECIES—

Upper Oligocene; *pseudodrillia* Powell, 1942. Recent: *abbreviata*, *affinis*, *biconica* and *gradata* Schepman, 1913.

#### Genus ISODAPHNE Laseron, 1954,

Roy. Zool. Soc. N.S.W. Handb., p. 44. Type (o.d.) *Isodaphne garrardi* Laseron, 1954.

##### Plate 20, fig. 15

Shell of moderate size, 15 mm., of light build, ovate-fusiform with rounded whorls, subangled at about upper third whorl height, and excavated over the neck. Protoconch tall, narrowly conical of  $4\frac{1}{2}$  diagonally cancellated whorls. Adult sculpture finely reticulated, consisting of closely spaced spiral threads, crossed by dense finer protractively oblique axial threads. Aperture ovate, short and wide. Sinus subsutural, wide and shallow. Colour fawn with reddish-brown subsutural patches and similarly coloured axial diffused streaks over the remainder of the whorls; protoconch deep chocolate. Range — Known only by the type species which is from 10-15 fathoms, Twofold Bay, southern New South Wales, Australia.

The genus is close to typical *Daphnella* but has a more clearly defined shoulder slope, an excavated base, a smaller and shorter aperture, and a wider more distinct sinus. It is more the shape of *Asperdaphne*, but that genus has a paucispiral protoconch, sculptured with dense spiral threads and developing two spiral keels on the last whorl. There is also some resemblance to *Cryptodaphne*, which has a polygyrate diagonally cancellated protoconch, but in that genus the adult whorls are pagodiform, strongly keeled towards the lower suture, and with a very long and straight steeply descending shoulder slope, resulting in a similarly long distinct reversed L-shaped sinus.

#### Genus ASPERDAPHNE Hedley, 1922,

Rec. Aust. Mus. 13(6), p. 338; nom. nov. for *Scabrella* Hedley, 1918, Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Daphnella versivestita* Hedley, 1912 (non *Scabrella* Sacco, 1890).

##### Plate 20, fig. 16

Shell rather small to medium sized, up to 22 mm., similar to *Daphnella* but of different build, being more regularly fusiform than elongate-ovate; coarser clathrate sculpture and with a distinctive protoconch, which is paucispiral, blunt tipped, closely packed with minute spiral threads and developing two spiral keels on the last whorl. The sinus is reversed L-shaped, broad and shallow. The aperture is rather short and broadly ovate in *Asperdaphne* but long and narrowly ovate in *Daphnella*.



Range — Recent and Miocene, Australia. Recent, New Zealand, Indonesia, Hongkong and Japan.

CHARACTERISTIC SPECIES—

AUSTRALIA, Recent — *amplecta* Hedley, 1922; *bastowi* (Gatliff & Gabriel, 1908); *bela* Hedley, 1922 (= *B. tasmanica* May, 1915); *bitorquata* (Sowerby, 1896); *brenchleyi* (Angas, 1877); *capricornea* and *compacta* Hedley, 1922; *desalesii* (Tenison-Woods, 1877) (= *sculptior* Tenison-Woods, 1879 = *sexdentata* Pritchard & Gatliff, 1900); *esperanza* (May, 1911); *hayesiana* (Angas, 1871); *moretonica* (Smith, 1882); *perplexa* (Verco, 1909) *rugosa* Laseron, 1954; *sculptilis* (Angas, 1871) (= *angasi* Hedley, 1903); *sepulta* Laseron, 1954; *tasmanica* (Tenison-Woods, 1877); *trimaculata* Cotton, 1947; *vercoi* (Sowerby, 1896); *versivestita* (Hedley, 1912); *vestalis* (Hedley, 1903); *walcotae* (Sowerby, 1893). Miocene — *balcombensis* and *contigua* Powell, 1944. NEW ZEALAND, Recent — *aculeata* (Webster, 1906); *expeditionis* Dell, 1956; *ula* (Watson, 1881). HONGKONG, Recent — *laceyi* (Sowerby, 1888). JAPAN, Recent — *peradmirabilis* (Smith, 1879).

Subgenus ASPERTILLA Powell, 1944 (of *Asperdaphne*),

Rec. Auck. Inst. Mus., 3(1), p. 60. Type (o.d.) *Drillia legrandi* Beddome, 1883.

Plate 20, fig. 18

Shell of small size, 3-7 mm., coarsely clathrate and with a moderately deep reversed L-shaped sinus. Distinguished from *Asperdaphne* mainly in the form of the protoconch, which is papillate of  $2\frac{1}{2}$  whorls, tip exserted, peg-like, the whole sculptured with ten spiral lirations, which terminate abruptly at the first axial of the post-nuclear sculpture. Range — Recent, Tasmania and Pliocene of South Australia.

CHARACTERISTIC SPECIES—

Recent: *legrandi* (Beddome, 1883). Pliocene: *exsculpta* Powell, 1944.

Genus FENESTRODAPHNE Powell, 1944,

Rec. Auck. Inst. Mus., 3(1), p. 61. Type (o.d.) *Fenestrodaphne pulchra* Powell, 1944.

Plate 20, fig. 19

Shell small, up to 6 mm.; ovate, similar to *Asperdaphne* but with a different protoconch. Sculpture of closely spaced narrow spiral cords, crossed by axial threads. Sinus reversed L-shape, not very deep. The distinctive feature is the protoconch, which is paucispiral, small, rounded, but flattened on top, of  $1\frac{1}{2}$  whorls, the tip inrolled; the whole closely axially costate, crossed by two weak spiral keels. Range — known only by the type species from the lower mid Pliocene of Abattoirs Bore, Adelaide, South Australia.

Genus PSEUDODAPHNELLA Boettger, 1895,

Nachrbl. dtsch. malak. Ges. 27, p. 58. Type (o.d.) *Clathurella philippinensis* Reeve, 1843.

Plate 20, fig. 20

Shell small to moderate sized, 4-18 mm., ovate-biconical with a moderately tall spire of

evenly convex whorls, and an ovate body-whorl, ending in a very short unnotched or very weakly notched anterior canal. Protoconch small, blunt, of 2-3 whorls, the first planorbid, the remainder tall with steep lightly rounded sides, and the whole sculptured with spiral lirae, crossed at right angles over the last whorl or so by numerous thin axial riblets, which results in a lattice effect, not a diagonal cancellation. Adult sculpture of regular narrowly crested axials, extending from suture to suture and over most of the base, overridden by closely spaced crisp spiral cords, which combined, enclose laterally elongated deep meshes. The points of sculptural intersection are beaded or weakly spinose. The aperture is wide and free from tubercles or plications on the columellar side, and mostly the outer lip is not variced. The sinus is sutural, drawn forward slightly initially, then vertically descending, after which it inclines steeply forward to join the arcuate sweep of the lower outer lip. The fasciole area is not differentiated. The colour in the type species is white, variously maculated in reddish-brown, mostly in intermittent vertical series of spots, associated with the beads or tubercles. Range — Indo-Pacific, Persian Gulf to the Philippines, Japan, Loyalty Islands, Queensland, New South Wales and Tasmania.

CHARACTERISTIC SPECIES—

*attenuata* Hedley, 1922, *barnardi* (Brazier, 1876), *crasselirata* (Hervier, 1896), *nexa* (Reeve, 1845), *philippinensis* (Reeve, 1843) and subsp. *major* Hervier, 1896, *pustulata* (Angas, 1877), *tincta* (Reeve, 1846).

Genus CACODAPHNELLA Pilsbry & Lowe, 1932,

Proc. Acad. Nat. Sci. Phil. p. 58. Type (o.d.) *Cacodaphnella delgada* Pilsbry & Lowe, 1932.

Plate 20, figs. 21, 22

Shell small, 8 mm., very slender, with a tall spire, almost twice the height of the aperture, and a narrow body-whorl, gradually tapered to a deeply notched short undifferentiated anterior canal. Protoconch turbinate, of  $2\frac{3}{4}$  convex whorls, the first  $1\frac{1}{2}$  smooth, the remainder with strong spiral cords crossed by thin axial riblets. This is followed by a whorl of clathrate sculpture composed of rather strong spiral and axial ribs, the latter protractively concavely arcuate. Remaining spire whorls with erect rounded axials, weak over the shoulder slope, and crossed below that area by three or four strong flattened spiral cords, which are subnodose at the points of intersection. The body-whorl from the top of the aperture to the anterior end is finely and densely spirally lirated, and minus axials. Aperture narrow; outer lip thin-edged but strengthened behind by a varix. Sinus sutural, rounded and moderately deep. No parietal callus or processes. Range — Known only by the type species which is from San Juan del Sur, Nicaragua.

Genus TRITONOTURRIS Dall, 1924,  
Proc. Biol. Soc. Washington, 37, p. 88. Type (o.d.)  
*Clathurella robillardi* "Barclay, 1869"=H. Adams,  
1869.

Plate 20, fig. 23

Shell of moderate size, up to 30 mm., of ovate-buccinoid shape, with a tall spire but an inflated body-whorl, truncated anteriorly. It has a true daphnellid reversed L-shaped sinus, but very shallow. Protoconch a tall narrowly conical four-whorled diagonally cancellated sinusigera. Sculpture, typically, boldly clathrate, but varying to axials dominant, crossed by weak spiral cords. The species *cumingii* is light brown with zones, lines and sparse maculations in reddish-brown; the protoconch also is reddish-brown. Other species are buff to light golden brown. Range — South Africa and Indo-Pacific, from Mauritius to Hawaii.

CHARACTERISTIC SPECIES—

*amabilis* (Hinds, 1843); *capensis* (Smith, 1882);  
*cumingii* (Powis, 1835); *elegans* (Pease, 1860);  
*menes* (Melvill, 1923); *paucicostata* (Pease,  
1860); *robillardi* (H. Adams, 1869).

Genus XANTHODAPHNE Powell, 1942,  
Bull. 2, Auckland Inst. Mus., p. 166. Type (o.d.)  
*Pleurotoma* (*Thesbia*) *membranacea* Watson, 1886.

Plate 21, fig. 1

Shell of moderate size, up to 24 mm., broadly ovate, almost globose, very thin, with a widely open aperture and a thin-edged, protractively arcuate outer lip. The columella is almost straight and the aperture narrows to a short unnotched anterior canal. The protoconch is missing in the type specimen, but a later described species, *maoria* Dell, 1956, has a two-whorled protoconch, first whorl small, the second wide and high, the whole very finely reticulated. Sinus at the suture, deep and wide. The surface of the adult shell is densely and finely striated, crossed by numerous thin axials, which are slightly stronger than growth lines. Range — New Zealand, 155-1100 fathoms.

CHARACTERISTIC SPECIES—

*maoria* Dell, 1956; *membranacea* and *xanthias* (Watson, 1886).

Genus EUBELA Dall, 1889,

Bull. Mus. Comp. Zool. 18, no. 29(2), p. 102. Type (o.d.) *Pleurotoma* (*Bela*) *limacina* Dall, 1881.

Plate 20, fig. 24

Shell small, 4-16 mm., elongate-ovate, mostly smooth and glossy except for a sub-sutural row of gemmules. Sinus moderately deep, reversed L-shaped. Protoconch polygyrate and diagonally cancellate. Range — Recent, 250-1270 fathoms, Florida to Brazil, off Panama, Indo-Pacific from East Africa to Japan and Hawaii. Miocene — New Zealand and also recorded from the European Miocene.

CHARACTERISTIC SPECIES—

Recent — Indo-Pacific — *aequatorialis* and *distincta* Thiele, 1925; *nipponica* Kuroda, 1938; *plebeja* Thiele,

1925; PANAMA — *imparella* Dall, 1908. CARIBBEAN — *limacina* (Dall, 1881) (=hormophora Watson, 1881); *mcgintyi* Schwengel, 1943. NEW ZEALAND: Miocene — *awakinoensis* Powell, 1942; *monile* Marwick, 1931. GERMANY: Miocene — *zetes* Kautsky, 1925.

Genus TYPHLODAPHNE Powell, 1951,

Discovery Rep. 26, p. 174. Type (o.d.) *Bela purissima* Strebel, 1908.

Plate 21, figs. 2, 3

Shell of moderate size, 20-25 mm., elongate-ovate, pure white, typically smooth and shining, but sometimes with faint spirals or narrow flexuous subobsolete axials. The genus resembles *Daphnella* in general facies, particularly in shape and in the reversed L-shaped sinus, but has a paucispiral bluntly rounded smooth protoconch of 1½ to 2 whorls, and a vestigial operculum, this feature, so far as is known, being entirely wanting in *Daphnella*. The operculum is leaf-shaped, with a terminal nucleus; in height it is less than a third of the aperture. The radula (text fig. F161) is toxoglossate, consisting of a pair of slender, straight, awl-shaped marginals only, which are barbed on one side, near the tip. That of *Daphnella* (*cancellata* Hutton) is curved, awl-shaped and is constricted from both sides near the tip but not barbed. Range — Patagonia, Cape Horn, South Georgia, Marion, Prince Edward and Kerguelen Islands, 90-177 metres.

CHARACTERISTIC SPECIES—

*corpulenta* (Watson, 1881); *filostriata* (Strebel, 1905); *platamodes* (Watson, 1881); *purissima* (Strebel, 1908); *strebli* Powell, 1951; *translucida* (Watson, 1881).

Genus BENTHODAPHNE Oyama, 1962,

Trans. Proc. Palaeont. Soc. Japan, N.S. 46, p. 272. Type (o.d.) *Pleurotoma* (*Bela*?) *glabra* Yokoyama, 1920.

Oyama introduced his genus as follows—

"Shell rather small, like *Spirotropis* or *Antiplanes* in general features; whorls rather flat smooth other than fine growth lines which are of the same type of that of *Daphnella*." . . . "This form differs from *Eubela* Dall, 1889, by lacking tubercles below suture. *Spirotropis* and *Antiplanes* have similar features though differing in growth lines."

Yokoyama's brief and rather inadequate description of the type species makes no reference to the protoconch, which from the illustration, appears to be paucispiral and bluntly rounded, but that may be just the result of wear.

Following is the original description of the type species (Yokoyama, 1920, Journ. Coll. Sci. Imp. Univ. Tokyo, art. 6, p.43, pl.2, figs. 1a-c) — "A single specimen. It is small, thin-shelled, short-fusiform with about six convex perfectly smooth whorls. The body whorl is longer than the spire. The inner lip is smooth



without any callus. The outer lip is thin and broken. The canal is recurved and broken at the anterior end, but it seems not to have been long. The sinus as judged by growth lines is near the suture, shallow with the lip-margin below it broadly arched. The diameter is 4 millim. The height, if perfect would be about 10 millim."

Japan, Koshiba Zone, Pliocene).

The sinus in *Benthodaphne* is of modified daphnellid reversed L-type. It descends steeply and retrocurrently from the suture, then about half way across the shoulder slope suddenly merges with the arcuate forward swing of the outer lip. A feature of the shell is the numerous distinct flexuous axial growth lines.

From the above it is certain that *Benthodaphne* has no relationship with *Spirotropis*, which is clavinid, *Antiplanes*, which is turrinid, or with *Eubela*, a daphnellid with straight-outlined spire whorls, smooth except for a subsutural band of gemmules. *Benthodaphne* appears to be a distinct genus, nearest perhaps to my *Typlodaphne*, which ranges in deep water from Patagonia to Kerguelen Islands, but a more exact evaluation must await more knowledge of the Japanese genus.

Unfortunately Oyama's paper became available to me too late to include an illustration of the type species. Also, reference to the genus is obscured by the fact that it is erroneously listed under pelecypoda in the Zoological Record (vol. 99, p.146).

#### Genus EUCYCLOTOMA Boettger, 1895,

Nachr. Malak. Gesell. 27, p. 55. Type (s.d. Cossmann, 1896) *Clathurella bicarinata* "Reeve" Pease, 1862. Syn. *Turhyssa* Dall, 1924, Proc. Biol. Soc. Washington, 37, p. 88. Type (o.d.) *Clathurella bicarinata* Pease, 1867.

#### Plate 21, fig. 4

Shell rather small, 8-16 mm., fusiform, with a tall spire but a truncated anterior end. Protoconch of 2-3 whorls, blunt-tipped and densely sculptured with granulose spiral lirae. Adult sculpture of a few strong, smooth spiral keels and dense axial interstitial threads. Aperture quadrate, terminating in a very short, obliquely twisted and very shallowly notched anterior canal. Sinus subsutural, a deep square-ended slot, occupying most of the shoulder slope. Range — Recent, Indo-Pacific, chiefly associated with the coral reef fauna; Mauritius, Philippines, Queensland, Melanesia, Samoa, Tuamotu Archipelago and Hawaii.

#### CHARACTERISTIC SPECIES—

*bicarinata* (Pease, 1862); *exilis* (Dunker, 1871); *fusiformis* (Garrett, 1873); *hindsii* (Reeve, 1843); *inquinata* (Reeve, 1845); *lactea* (Reeve, 1843); *nobilis* Hedley, 1922; *tricarinata* (Kiener, 1839-40); *triviricosa* (Martens, 1880).

#### Genus MAORIDAPHNE Powell, 1942,

Bull. No. 2, Auck. Inst. Mus., p. 162. Type (o.d.) *Daphnella clifdenica* Laws, 1939.

#### Plate 21, fig. 5

Shell small, 4.5-6.5 mm., ovate-fusiform, thin, but prominently sculptured with cytharid-like axials, crossed by spiral cords. Protoconch large, polygyrate, sharply conical of 4-6 diagonally cancellated whorls, of which the lower ones are slightly angulate. Outer lip thin-edged, weakly variced and with a very slight subsutural sinus. Range — Oligocene and Miocene of New Zealand.

#### CHARACTERISTIC SPECIES—

Oligocene — *haroldi* Powell, 1942; *kaiparica* (Laws, 1939). Miocene *clifdenica* (Laws, 1939).

#### Subgenus KUROSHIODAPHNE Shuto, 1965 (of *Maoridaphne*),

Mem. Fac. Sci. Kyushu Univ. ser. D, Geol. 16, 2, p. 192. Type (o.d.) *Daphnella fuscobalteata* Smith, 1879.

#### Plate 21, figs. 6, 7

Shell small, 10-12.5 mm., very similar to *Maoridaphne* in adult facies, except that the anterior canal is a little longer and more clearly differentiated, due to a greater excavation of the base, which forms a distinct neck. The protoconch of *Kuroshiodaphne* is small, bluntly conical, of about three whorls, the first one and a third volutions smooth, the remainder finely diagonally cancellated. The protoconch in *Maoridaphne* is sharply conical of 4-6 whorls, which are diagonally cancellated throughout. Range — Recent and Pleistocene of Japan.

#### CHARACTERISTIC SPECIES—

*fuscobalteata* and *subzonata* (Smith, 1879).

#### Genus PUHA Marwick, 1931,

New Zealand Geol. Surv. Pal. Bull. 13, p. 150. Type (o.d.) *Puha fulgida* Marwick, 1931.

#### Plate 21, fig. 8

Shell small, 5-12.5 mm., fusiform, with a tall turreted spire and a full body-whorl, slowly tapered to a rather narrowly open, short, unnotched anterior canal. Protoconch tall, narrow, polygyrate and diagonally cancellated. Adult sculpture of strong axials, tuberculate both at the subsutural fold and also at the peripheral angle. Strong regular spirals continue from the periphery to the anterior end; there is no anterior fasciole. Outer lip thin, very slightly channelled above, but without a definite sinus. Inner lip, in the type species, longitudinally grooved near its raised outer edge; comparable with the pillar plications in some species of *Daphnella*. The genus resembles the North German Miocene *Magnella* in general facies, but that genus has a prominently twisted anterior end. *Puha* is probably nearer related to *Maoridaphne* which differs mainly in its non-turreted spire and continuous cytharid axials, undiminished over the shoulder slope. Range — Oligocene and Miocene, New Zealand.

## CHARACTERISTIC SPECIES—

Oligocene: *pusula* Laws, 1947; *sinusigera* Powell, 1942; *hebes* (Hutton, 1873). Miocene: *fulgida* Marwick, 1931.

*Note* — A Japanese Pliocene species, described as *Puha japonica* Shuto, 1961 (Mem. Fac. Sci. Kyushu Univ. ser. D, Geol. 11(2), p. 138) is very doubtfully a member of that genus. Shuto's shell has an excavated base, relatively long canal and a different protoconch, which is four-whorled, but three of these are smooth and only the last one is diagonally cancellated.

Genus **MAGNELLA** Dittmer, 1960,

N. Jb. Geol. Paläont. 9, p. 425. Type (o.d.) *Magnella andersoni* Dittmer, 1960.

*Plate 21, fig. 9*

Shell small, 4.57 mm., fusiform, with a tall turreted spire, but truncated anteriorly, ending in a decidedly twisted columella and short unnotched anterior canal. The protoconch is relatively large, polygyrate, narrowly conical and diagonally cancellated. The sinus is very slight; the thin outer lip descends straight and retrocurrently, then at about the peripheral carina it inclines gently forward. The adult sculpture is of strong cytharid-like axials, nodulose, both on the subsutural fold and at the periphery; the spiral sculpture consists of a moderate subsutural fold, a strong peripheral keel, and four strong linear spaced cords on the lower base. Range — known only by the type species which is from the Hemmoor Miocene of Schleswig-Holstein, North Germany. The genus has a striking resemblance to the New Zealand Oligocene — Miocene *Puha*, but in that genus the anterior end is not twisted.

Genus **PLEUROTOMELLA** Verrill, 1873,

Amer. Journ. Sci., ser. 3, 5, p. 15. Type (monotypy) *Pleurotomella packardii* Verrill, 1873.

*Plate 21, fig. 10*

Shell of small, moderate or large size, 4-75 mm., rather thin, broadly biconic to ovate, usually with conspicuously angulated whorls. Protoconch of 3-4½ whorls, narrowly conical to turbinate, either diagonally cancellated, or closely axially ribbed, crossed by spiral threads. Adult sculpture of flexuous protractive fold-like axials, which are usually thickened over the peripheral area. The shoulder sulcus is closely axially ribbed, arcuately protractive, following the curve of the sinus. The whole surface is crossed by spiral cords and threads, weaker over the shoulder sulcus. Spire of equal height, or greater than that of the aperture plus the canal. Body-whorl capacious, excavated somewhat over the neck. Outer lip thin-edged, with a deep sutural sinus, rounded at its apex, which is at or above the middle of the shoulder slope, and merged below into a great forward swing of the lower outer lip. The ovate-pyriform aperture terminates in a

short flexed, spout-like anterior canal. Inner lip smooth callused, without processes. Colour white, often covered by a pale olive periostracum. Operculum absent. Radula (*agassizi*; text fig. F162) of loose marginals of the hafted-dagger type, slender, slightly hollowed, gradually tapered to a very fine point, and with a knuckle-shaped base, from which the haft extends. There is no constriction near the pointed extremity, as in *Daphnella* (*agassizi*). Range — The genus is characteristic of the deep ocean basins, particularly those of the North Atlantic, where species occur often between 2000 and 3000 metres, and in one instance to as deep as 5413 metres. The genus occurs also in the deep basins of the Indo-Pacific and Southern Ocean, but not nearly so frequently as in the Atlantic.

## CHARACTERISTIC SPECIES—

(Atlantic) — *agassizi* Verrill & Smith, 1880 and subsp. *mexicana* Dall, 1889, *permagna* and *sandersoni* Verrill, 1884, *anceyi* (Dautzenberg & Fischer, 1897), *araneosa* (Watson, 1881), *atlantica* (Locard, 1896), *bairdi* Verrill & Smith, 1884, *bandella* (Dall, 1881) (= *diomedae* Verrill & Smith, 1884), *bruneri* Verrill & Smith, 1884, *brychia* (Watson, 1881), *bulbulina* Locard, 1897, *bullioides* Sykes, 1906, *bureaui* (Dautzenberg & Fischer, 1897), *cala* (Watson, 1886), *callembrion* (Dautzenberg & Fischer, 1896), *catherinae* Verrill & Smith, 1884, *chariessa* (Watson, 1881), *chevreuxi* (Dautzenberg & Fischer, 1897), *chyta* and *circumvoluta* (Watson, 1881), *coelorhaphie* (Dautzenberg & Fischer, 1896), *dalmasi* (Dautzenberg & Fischer, 1897), *demisia* (Dautzenberg & Fischer, 1896), *demulcata* Locard, 1897, *diastrophia* Dautzenberg & Fischer, 1896, *emertoni* Verrill & Smith, 1884, *eurybrocha* (Dautzenberg & Fischer, 1896), *filifera* (Dall, 1881), *frielei* Verrill, 1885, *fulvotincta* and *gisota* (Dautzenberg & Fischer, 1896), *gregaria* Sykes, 1906, *heterogramma* Odhner, 1960, *homaeotata* (Watson, 1886), *incincta* (Watson, 1881), *koehleri* Locard, 1895, *lamyi* Dautzenberg, 1925, *leptoconcha* (Locard, 1897), *leptoglypta* (Dautzenberg & Fischer, 1896), *lottae* Verrill, 1885, *macra* (Watson, 1881), *packardii* Verrill, 1873 and subsp. *benedicti* Verrill & Smith, 1884, and *formosa* (Jeffreys, 1883), *pandionis* Verrill, 1880, *perpauilla* (Watson, 1881), *phyxanor* (Watson, 1886), *polysarca* (Dautzenberg & Fischer, 1896), *porcellana* and *pruina* (Watson, 1886), *pu dens* (Watson, 1881), *pyrrhogramma* and subsp. *multicostata* and *robusta* (Dautzenberg & Fischer, 1896), *subaraneosa* (Dautzenberg & Fischer, 1896), *tenellunum* Locard, 1896, *tincta* Verrill, 1885, *vayssierei* (Dautzenberg, 1925), *vitrea* Verrill, 1885, *watsoni* (Dautzenberg, 1889). (Indo-Pacific)—*puella* Thiele, 1925. (West America) — *herminea* and *oceanida* Dall, 1919. (Antarctica) *papyracea* Watson, 1886, *simillima* Thiele, 1912.

The above list is a conservative one. A great number of species attributed to this genus has been described, but many of the Indo-Pacific ones have been excluded, since, although they superficially resemble *Pleurotomella*, the sinus is very slight, and often the protoconch is atypical also.

The genus is also claimed to occur from the Oligocene to the Pliocene of Europe and the Tertiary of the East Indies, Japan and North America, but critical examination of apices will be necessary to evaluate these claims. For European Eocene species attributed to *Pleuro-*



*tomella*, see the "subgenus" *Systemope*, and for Antarctic and Subantarctic pleurotomellids, with a paucispiral smooth protoconch, see the new subgenus, following.

Subgenus **SYSTEMOPE** Cossmann, 1889 (of *Pleurotomella*),

Ann. Soc. Malac. Belg. 24, p. 289. Type (o.d.) *Raphitoma* (*Systemope*) *polycolpa* Cossmann, 1889.

Plate 21, figs. 11, 12

Cossmann, later, (1896, Essais Pal. Comp. 2, p. 133) relegated his 'section' to the synonymy of *Pleurotomella*, and this course has been followed by most subsequent writers, with the exception of Woodring (1928, Carnegie Inst. Wash. publ. no. 385, p. 196), who remarked that this action required confirmation.

Cossmann's original figure shows a shell, not unlike *Pleurotomella*, being rather openly clathrate and with characteristic closely spaced fine arcuate axial ribs on the shoulder slope, retractive and coinciding with successive positions of the anal sinus, which appears to be sutural and not very deep. The protoconch, however, differs from the diagonally cancellate one of typical *Pleurotomella*, according to Cossmann's figure (1896, l.c. p. 134, text fig. 36), in having about  $2\frac{1}{2}$  whorls, the first smooth, then closely axially costate. The type species is a small shell, 5.5 mm., from the Eocene of Le Fayel, France.

Provisionally, *Systemope* may be used as a subgenus of *Pleurotomella* for the French Eocene species listed by Cossmann (1896, l.c., p. 134), namely—*goniocolpa*, *guelpellensis*, *linophora* and *polycolpa* (Cossmann, 1889).

Subgenus **THETA** Clarke, 1959 (of *Pleurotomella*),

Proc. Malac. Soc. 33, 5, p. 234. Type (o.d.) *Pleurotomella* (*Theta*) *lyronuclea* Clarke, 1959.

Plate 21, fig. 13

Shell small, 9-10 mm., similar to *Pleurotomella* but with a different protoconch, which is large, broadly conical of  $3\frac{1}{2}$  whorls, sculptured with numerous thin axial riblets; that of the typical genus is diagonally cancellated. Adult sculpture distinctive, consisting of flange-like peripheral nodes. Sinus shallow, sutural. Colour white. Range — Known only by the type species which is from off Bermuda in 2,843 fathoms.

Subgenus **ANTICLINURA** Thiele, 1934 (of *Pleurotomella*),

Handb. Syst. Weicht. 2, p. 1002, nom. nov. for *Clinuropsis* Thiele, 1929, Handb. Syst. Weicht. 1, p. 372 (non Vincent, 1913). Type (o.d.) *Clinura monochorda* Dall, 1908. Syn. *Clinuromella* Beets, 1943, Leid. geol. Meded. 13, p. 356, nom. nov. for *Clinuropsis* Thiele, 1929.

Plate 21, fig. 14

Shell rather small, 9-11.5 mm., thin, covered by a thin yellowish or greyish periostracum,

biconic-fusiform, with medially sharply angled whorls. Protoconch eroded away in all known examples. Adult sculpture of sharp narrow axial ribs crossed by rather closely spaced narrow sharply raised spiral cords. Body-whorl quickly contracted to a relatively long straight unnotched anterior canal. Sinus wide and shallow, occupying the whole of the shoulder slope. Operculum absent.

The latest opinion (Charig, 1963, Bull. Brit. Mus. Nat. Hist., Geol. 7, 9, p. 263) is that *Anticlinura* should continue to remain where Thiele placed it (1929, Handb. Syst. Weicht. 1, p. 371) as a "n. sect." or subgenus of *Pleurotomella*. Range — Recent, Gulf of Panama, 1020 fathoms and off Peru in 1036 fathoms.

CHARACTERISTIC SPECIES—

*monochorda* and *peruviana* (Dall, 1908).

Subgenus **ANOMALOTOMELLA** n. subgen. (of *Pleurotomella*),

Type *Pleurotomella anomalapex* Powell, 1951.

Plate 21, fig. 15

This name is provided for a group of Antarctic-Subantarctic pleurotomellids that have all the characteristics of the typical genus, except for a paucispiral protoconch of two whorls. It is introduced mainly to observe the precedent for similar action that is maintained for other turrid pairs which divide into two series, distinguishable only by their respective protoconchs, paucispiral and blunt on the one hand, polygyrate and narrowly conical on the other, as instanced by *Liophiotoma* v. *Lophioturris* and *Tomopleura* v. *Maoritomella*.

Until the true significance of this nuclear divergence is resolved it is considered preferable to segregate such pairs. Range — South Atlantic, Southern Ocean and Antarctica.

CHARACTERISTIC SPECIES—

*annulata* Thiele, 1912, *anomalapex* Powell, 1951, *enderbyensis* Powell, 1958, *frigida* Thiele, 1912 and *ohlina* (Strebel, 1905).

Genus **GYMNOBELA** Verrill, 1884,

Trans. Connecticut Acad. 6, 1, p. 157. Type (s.d. Cossmann, 1896) *Gymnobela engonia* Verrill, 1884.

Plate 21, fig. 16

Shell of small to moderate size, 6-24 mm., thin-shelled, ovate-biconical, with a broad conical tabulated relatively short spire, and an inflated body-whorl, only weakly excavated over the neck, and terminated in a short spout-like anterior canal. Protoconch broadly conical of  $2\frac{1}{2}$ -3 finely diagonally cancellated whorls. Adult sculpture of numerous narrow flexuous, sometimes lamellose axials, overridden by closely spaced spiral cords or threads. There is a pronounced angulation of the whorls at above middle whorl height, and upon this the axials are often more or less tuberculate. The shoulder slope is crowded with straight retrac-



tive thin axials that represent successive positions of the anal sinus. Sinus reversed L-shaped, not very deep, occupying the whole of the shoulder slope, descending straight and retractively from the suture, its rounded apex near to the peripheral carina, after which the lower edge runs forward and slightly downward, to join the thin protractively arcuate outer lip. Inner lip smooth callused, without processes of any kind. Operculum absent. Colour white. Range — Recent, deep-water, 100-3660 metres, off New England, 1290 fathoms (type species), West Atlantic, Florida, Caribbean, Gulf of Guinea, South Africa, Zanzibar, Panama, Galapagos and Peru.

The genus resembles *Pleurotomella* but has a much shallower sinus, and in general is of more ovoid shape, with a short spire and angulated whorls.

#### CHARACTERISTIC SPECIES—

West Atlantic to Caribbean — *blakeana* (Dall, 1881) (= *brevis* Verrill, 1885) and subsp. *agria* Dall, 1889, *curta*, subsp. *subangulata* and *engonia* Verrill, 1884, *extensa* (Dall, 1881) (= *streptophora* Watson, 1881), *grundifera* Dall, 1927, *hebes* (Verrill, 1880), *illicita*, *imitator* and *lanceata* Dall, 1927, (Gulf of Guinea) — *camerunensis* and *rhomboidea* Thiele, 1925 (South Africa) — *augusta* Thiele, 1925, (East Africa)—*clara* and *erronea* Thiele, 1925, (Panama) — *isogonia* Dall, 1908, (Galapagos) — *agonia* (Dall, 1889) and subsp. *altina* (Dall, 1908), *xylona* (Dall, 1908), Peru — *egregia* (Dall, 1908).

#### Genus PHYMORHYNCHUS Dall, 1908,

Bull. Mus. Comp. Zool. 43, 6, p. 258. Type (o.d.) *Pleurotomella castanea* Dall, 1895.

##### Plate 21, fig. 21

Shell large, 25-73 mm., thin, broadly fusiform, closely spirally ridged to almost smooth, with a tall spire of subangulate whorls and an inflated body-whorl, much constricted over the neck, but with a very short spout-like anterior canal. Protoconch eroded in all known examples. Aperture rather large, broadly ovate-pyriform. Outer lip thin; sinus sutural, wide and shallow. Inner lip broadly but thinly callused and without denticles or plicae. Animal blind and with a distinct muzzle, into which the long proboscis is retracted. A poison gland is present, and the radula (text figs. F163, 164) is toxoglossate, closely resembling that of *Pleurotomella*. Operculum absent. Range — Off Ecuador, the Galapagos and Panama in 740-1772 fathoms; also mid North Pacific in 2368 fathoms. The type species is from 1322 fathoms off the Galapagos Islands.

#### CHARACTERISTIC SPECIES—

*argeta* (Dall, 1889), *castanea* (Dall, 1895), *cingulata* (Dall, 1889), *clarinda* and *oceanica* (Dall 1908).

Genus EURYENTMEMA Woodring, 1928, Carnegie Inst. Wash. publ. no. 385, p. 195. Type (o.d.) *Euryentmema cigclis* Woodring, 1928.

##### Plate 21, fig. 17

Shell small, 5-9.3 mm., fusiform-ovate, with a moderately tall spire of strongly convex,

weakly shouldered whorls, and a rounded body-whorl, excavated over the neck, and terminated in a short shallowly notched anterior canal. Protoconch stout, cylindrical, of about 1½ smooth whorls, with a few subsutural axial wrinkles near its close. Adult sculpture of numerous narrow flexuous axial ribs, overridden by crisp spiral cords, which are slightly gemmulate at the points of intersection. The axials are continuous from suture to suture on the first post-nuclear whorl, but later become subobsolete over the shallow shoulder sulcus, which leaves the commencement of the axials as a sutural row of gemmules. Aperture wide, outer lip thin-edged, with a deep and wide sutural sinus "like *Pleurotomella*" (i.e., reversed L-shape); also with a relatively deep stromboid notch below. Parietal callus thin, no apertural processes. Range — Known by the type species and an undescribed one, both from the Miocene of Bowden, Jamaica.

I have not seen specimens of this species but from the author's comparison of his genus with *Pleurotomella*, it would seem to belong to the *Daphnellinae*.

#### Genus BUCCINARIA Kittl, 1887,

Ann. d.k.k. naturh. Hofmus (Wien), 2, p. 251. Type (o.d.) *Buccinaria hoheneggeri* Kittl, 1887.

##### Plate 21, fig. 18

Shell of moderate size, 15.5 mm. or more, ovate-pyriform to buccinoid, with a broadly conical spire. Body-whorl broadly ovate, gradually tapered to a short widely open weakly emarginate anterior canal. Protoconch of 2-2½ whorls, that form a small sharp, narrowly conical tip. Except for the first half whorl the protoconch is diagonally cancellated. Outer lip thin, gently curving and narrowly insinuated to form a weak sinus in the vicinity of the shoulder slope. Adult sculpture of peripheral axial nodes, which diminish rapidly both above and below. The whole surface is strongly sculptured with flat-topped spiral cords, separated by deeply incised linear grooves. The shell has a strong superficial resemblance to an *Acamptogenotia* or an *Austrotoma*. The subgenus *Ootomella* has much weaker axial and spiral sculpture, lacks peripheral nodes, except on the early spire whorls, and has a wider subsutural fold. The two, however, are obviously very closely related and may yet prove to be representative of but a single genus. Range — Miocene of the Vienna Basin, Austria and Miocene—Pliocene of Okinawa.

#### CHARACTERISTIC SPECIES—

Miocene, AUSTRIA; *hoheneggeri* and *orlaviensis* Kittl, 1887. Miocene or Pliocene, OKINAWA; *okinawa* Mac Niel, 1960; JAVA, *javanensis* Altena, 1950.

Subgenus OOTOMELLA Bartsch, 1933 (of *Buccinaria*),

Nautilus, 47 (2), p. 76 (nom. nov. for *Ootoma* Koperberg, 1931. Jaarb. Mij. Ned. — Indie, p.



48) (non Dejean, 1833, non Blanchard, 1850). Type (o.d.) *Ootoma jonkeri* Koperberg, 1931). Syn. *Pionotoma* Kuroda, 1952, *Venus*, 17 (2), p. 65. Type (o.d.) *Pionotoma pyrum* Kuroda, 1952.

Plate 21, fig. 19

Shell of moderately large size, up to 30 mm., ovate-pyriform, solid, with a broadly conical spire and a swollen body-whorl, tapered to a short slightly flexed, very slightly notched, spout-like anterior canal. Protoconch large, broadly conical of five whorls, which are sculptured with protractively arcuate thread-like axials, reticulated by cross threads, over the lower half of the whorls only, and ending in a rounded varix, the upper portion of an otherwise immersed sinusigerid claw (*pyriformis* Schepman). Adult whorls with a very broad swollen subsutural fold, followed by a narrow, shallow shoulder sulcus. Sculpture of incised spiral lines, crossed by numerous axials, moderately strong on the early whorls but weak to subobsolete, and decidedly flexuous, over the body-whorl. The sinus is an almost imperceptible shallow insinuation in the vicinity of the shoulder sulcus. Range — Recent, East Indies to Japan, Pliocene, Timor and Okinawa, Miocene or Oligocene, Buton Island, Indonesia

CHARACTERISTIC SPECIES—

Recent, CERAM SEA, *pyriformis* (Schepman, 1913). JAPAN, *pyrum* and *teramachii* (Kuroda, 1952). Pliocene, TIMOR, *jonkeri* and *martini* Koperberg, 1931; *koperbergi* (Martin, 1933). OKINAWA, *loochooensis* Mac Neil, 1960. Miocene or Oligocene, BUTON ISLAND, *retifera* (Martin, 1933).

Genus PHILBERTIA Monterosato, 1884,

Nomencl. Conch. medit. p. 132. Type (tautonymy) *Pleurotoma philberti* Michaud, 1830. Syns. *Cirillia* Monterosato, 1884, Nomencl. Conch. medit. p. 133. (non Rondani, 1856). Type (monotypy) *Pleurotoma linearis* Montagu, 1803. *Cordieria* Monterosato, 1884, Nomencl. Conch. meded. p. 131 (non Rouault, 1848). Type (tautonymy) *Pleurotoma cordieri* Payraudeau, 1826. *Homotoma* Bellardi, 1875, Bull. Soc. malac. Ital. 1, p. 22, (non Guérin-Ménéville, 1844). Type (here selected) *Murex reticulatus* Renier, 1804. *Leufroyia* Monterosato, 1884, Nomencl. Conch. medit. p. 134. Type (tautonymy) *Pleurotoma leufroyi* Michaud, 1828. *Peratotoma* Harris & Burrows, 1891, Eoc. Olig. Beds Paris Basin, 98, p. 113; nom. nov. for *Homotoma* Bellardi, 1875.

Plate 21, fig. 20

This is a difficult genus to evaluate nomenclaturally as can be judged by the above extensive synonymy. These shells were long covered by either the preoccupied and misapplied *Defrancia* Millet, 1826, or by *Clathurella* Carpenter, 1857, a name formerly interpreted as a substitute for the preoccupied *Defrancia*, but now limited to a tropical West American group akin to the mangelinid genus *Glyphostoma*.

Shell of moderate size, 10-25 mm., rather thin, fusiform, with a tall spire of evenly convex whorls and an ovate body-whorl, deeply excavated over the neck to a short, deeply

channeled but scarcely emarginate anterior canal. Protoconch small, papillate, of 2-2½ whorls, the first 1½ whorls spirally lirate, the interstices crossed by fine axial threads, last whorl faintly diagonally cancellated (*linearis*). Adult sculpture a dense pattern of numerous narrowly rounded but sharply raised axials, overridden by closely spaced strong cords. Aperture narrowly ovate; outer lip thin edged, but strengthened within by a callused ridge which is sculptured with numerous spiral plicae. Sinus sutural, small, but distinct, and of reversed L-shape. Inner lip a thin clearly defined callus, without denticles or plicae. Colour light yellowish-brown to purplish-brown, variously streaked and narrowly banded in white. Radula (*leufroyi*, text fig. F155), a pair of slender simple-pointed marginals, with a spatulate base. Range — Typically, the genus is found Recent from Norway to the Mediterranean and West Africa, and in the Pliocene and Miocene of Europe. Many Indo-Pacific species, described as *Clathurella* are better located in *Kermia*, which is typified by small narrowly cylindro-ovate shells.

CHARACTERISTIC SPECIES—

*concinna* (Scacchi, 1836), *cordieri* (Payraudeau, 1826), *leufroyi* (Michaud, 1828) (= *boothii* S. V. Wood, 1848), *linearis* (Montagu, 1803) (= *elegans* Bellardi, 1877), *papillosa* Pallary, 1904, and subsp. *arnoldi* and *bedei* Pallary, 1906, *philberti* (Michaud, 1829), *pruinosa* Pallary, 1906, *purpureus* (Montagu, 1803), *reticulatus* (Renier, 1804).

The above is a very cursory assessment of the genus, for much work requires to be done to satisfactorily evaluate the large number of species, mainly described under *Clathurella* (auct.), from Indo-Pacific, West American and Caribbean localities, as well as many from a wide range of localities in the Tertiary.

Genus KERMIA Oliver, 1915,

Trans. N.Z. Inst. 47, p. 539. Type (o.d.) *Kermia benhami* Oliver, 1915. Syn. *Clathurina* Melvill, 1917, Proc. Malac. Soc. 12, p. 185. Type (o.d.) *Pleurotoma foraminata* Reeve, 1845 (intended as a substitute name for the preoccupied *Clathurella* Carpenter, 1857, but a new proposition since a type was designated).

Plate 22, figs. 1, 2

Shell small, 4-11 mm., but occasionally up to 18 mm., elongate-cylindrical, body-whorl more than half the height of the shell. Protoconch of 2-2½ whorls, the first smooth, the remainder with concave axial threads, reticulated over the lower half of the whorls by cross threads. Adult sculpture densely reticulated by narrow axial ribs, overridden by less prominent narrow spiral cords, forming beads at the intersections. Outer lip strongly variced, crossed by the spirals, and denticulate within. Sinus deep, U-shaped, a subsutural excavation in the labial varix. Inner lip smooth. Colour of the type species uniformly dark brown, except for the protoconch, which is paler. The genus resembles *Philbertia*, but it is smaller and



constantly of narrowly cylindrical shape. The chief difference, however, is in the sinus, which is deep U-shaped, and drawn forward suturally by a heavy callosity. Range — Indo-Pacific, Mauritius to Japan, New Ireland, Queensland, Loyalty Islands and the Kermadecs.

CHARACTERISTIC SPECIES—

*benhami* Oliver, 1915, *catharia* (Melvill, 1917), *episema* (Melvill & Standen, 1896), *felina* (Hinds, 1843), *foraminata* (Reeve, 1845), *harenula* and *retellaria* (Hedley, 1922), *subcylindrica* (Hervier, 1896), *tessellata* (Hinds, 1843) (= *mauritiana* Sowerby, 1893) and *tokyoensis* (Pilsbry, 1895).

Genus **ANTIMITRA** Iredale, 1917,

Proc. Malac. Soc. 12 (6), p. 329. Type (o.d.) *Pleurotoma aegrota* Reeve, 1845.

Plate 22, fig. 3

Shell rather small, 7-11.5 mm., narrowly fusiform, with a tall spire about  $1\frac{1}{2}$  times the height of the aperture, and a narrow subcylindrical body-whorl, gradually tapered to a moderately long weakly notched anterior canal. Protoconch (*aegrota*), narrowly conical of probably 4-5 convex-sided whorls (tip missing in available material), the last whorl weakly bicarinate, and the whole densely and minutely pitted, being the interstices of an exceedingly fine and dense transverse reticulation. There is a brephic stage of several very protractively oblique axials, and a strengthening of the bicarinate spirals, before passing into the adult sculpture, in which the axials are nearer vertical. Adult sculpture a reticulation of dense crisp narrow axials overriden by equally numerous narrow sharply raised spiral cords. There is a distinct angulation at about four-fifths whorl height. Aperture long and narrow; outer lip thin edged but backed by a broad low varix. Sinus subsutural, U-shaped, but with a downward trend, the upper edge drawn forward at the suture, where it merges with a moderate entering parietal callus pad. Columellar callus without plicae or processes of any kind. Colour uniformly white or buff. Range — Recent, Singapore to Japan and Polynesia.

The genus is like a very slender *Daphnella*, but the sinus is different from the characteristic reversed L-form, and the protoconch differs also in its exceedingly fine pitted surface.

CHARACTERISTIC SPECIES—

*aegrota* (Reeve, 1845), *lirata* (A. Adams, 1865), *crenulata* (Pease, 1867).

Genus **COMARMONDIA** Monterosato, 1884,

Nomencl. Gen. Spec. Conch. Medit. p. 135, nom. nov. for *Bellardia* Bucquoy, Dautzenberg & Dollfus, 1883, Moll. Mar. Roussillon 1, pp. 85, 88 (non Robineau-Desvoidy, 1863, non Rondani, 1864, non Mayer, 1870). Type (o.d.) *Murex gracilis* Montagu, 1803. Syns. *Bellardiella* Fischer, 1883, Man. Conch. p. 594, nom. nov. for *Bellardia* Bucquoy, Dautzenberg & Dollfus, 1883. *Bellatula* Strand, 1928, Arch. Naturgesch. 92, A8, p. 39, nom. nov. for *Bellardiella* Fischer, 1883.

Plate 22, figs. 4, 5

Shell of moderate size, 20-23 mm., rather

thin, elongate-fusiform, with a tall spire of convex whorls, and a narrow, rounded body-whorl, quickly contracted to a relatively long, flexed and recurved anterior canal, with a wide moderately deep anterior notch. Protoconch small, narrowly conical, of about  $2\frac{1}{2}$  whorls, the tip blunt and asymmetrically inrolled and with a weak submedian carina over the last  $1\frac{1}{2}$  whorls; surface extremely finely pitted, resulting in a form of reticulation. Adult sculpture of closely spaced oblique broadly rounded axials, which commence abruptly at the lower margin of a moderately wide subsutural sulcus. The whole surface, including the shoulder sulcus, is crossed by linear spaced weak spiral cords. Sinus sutural, rather deep, slightly drawn forward at the suture, its apex broadly rounded, and its lower margin produced forward and parallel to the suture, then descending abruptly to the forwardly swinging thin edged outer lip, which is strengthened behind by a strong broadly rounded varix. Colour buff to light brownish with a darker reddish-brown band on the lower part of the shoulder slope, and another on the upper base immediately below a white zone, which encircles the body-whorl at the level of the lower suture.

The genus resembles *Philbertia* in general facies but that genus has a strongly diagonally cancellated protoconch, a much shallower posterior sinus, and a different style of outer lip, which does not incline forward below, nor is it variced behind. The spiral and axial sculpture of the adult whorls in *Philbertia* is more equalised, which results in a clathrate effect; in *Comarmondia* the spiral sculpture is subsidiary to the axial. Range — Recent, England, southern Europe, the Mediterranean and Canary Islands; Miocene to Pleistocene of Italy and Sicily.

CHARACTERISTIC SPECIES—

*gracilis* (Montagu, 1803) (= *emarginatus* (Donovan, 1804), = *branscombi* (Clark, 1849) = *oblongus* (Brocchi, 1814).

There are doubtless a number of European Tertiary species that may prove to belong to the genus. Regarding seventeen Recent Indo-Pacific species attributed to *Bellardiella*, described by Thiele (1925, Deutsch. Tiefsee-Exped. 17, 2), these are an incongruous assortment, some belonging to *Etrema* and none very close to typical *Comarmondia*.

Genus **THESBIA** Jeffreys, 1867,

Brit. Conch. 4, p. 359. Type (monotypy) *Tritonium nana* Lovén, 1846.

Plate 19, fig. 22

Shell small, 6 mm., ovate-fusiform, thin, white, with a moderately tall spire of evenly rounded whorls, and a rather inflated body-whorl, quickly contracted to a short flexed weakly notched anterior canal. Protoconch smooth of about  $1\frac{1}{2}$  whorls, the tip laterally inrolled. Adult sculpture of closely spaced flat-



topped spiral lirae, the linear interspaces punctate. Aperture subquadrate, slightly expanded. Outer lip thin-edged, subsuturally broadly but very shallowly insinuated, scarcely a sinus. No operculum (Jeffreys). Radula (text fig. F157), very similar to that of *Philbertia leufroyi* (text fig. F155), a pair of slender, simple-pointed marginals, with a spatulate base. Range — Recent, northern Europe.

Cossmann's (1896, *Essais Pal. Comp.* 2, p. 137) claim of a Parisian Eocene member of the genus (*microtoma* Cossmann, 1899) is very doubtful, since the figure shows a slight but quite definite daphnellid sinus. Again, Watson's *Pleurotoma* (*Thesbia*) *membranacea* (1886), is not that genus but is now the type of *Xanthodaphne*, a New Zealand deep-water genus.

Despite the obsolete sinus, the style of radula, coupled with the absence of an operculum, suggests that *Thesbiu* may be located provisionally in the Daphnellinae.

Genus PONTIOTHAUMA E. A. Smith, 1895, *Ann. Mag. Nat. Hist.*, ser. 6, 16, p. 2. Type (o.d.) *Pontiothauma mirabile* E. A. Smith, 1895.

Plate 22, fig. 8

Shell very large and capacious, up to 136 mm., thin, fusiform to bucciniform, with a tall spire of rounded to narrowly tabulated whorls, and typically, a rather large broadly ovate aperture, constricted below to a short straight unnotched anterior canal. Sculpture of numerous oblique fold-like axials, overridden by spiral lirae. Outer lip thin, with a very slight almost non-existent sutural sinus. Operculum absent. Radula (text figs. F165-167) toxoglossate, consisting of a pair of slender awl-shaped marginals, weakly barbed at the tip, and furnished with poison gland, duct and muscular bulb. Cephalic tentacles rather short, apparently without eyes, for there is no eye-ledge, nor are there pigment spots. The rostral region of the animal is very prominent, and with a complicated introvert apparatus. A similar rostral development, or muzzle, is found in the daphnellid genus *Phymorhynchus*.

Another species, *Pontiothauma abyssicola* Smith, 1895, has a turreted spire and a flexed buccinid-like termination to the aperture, but the radula is toxoglossate, except that the teeth are without barbs. However there is a poison gland and duct, and a muzzle, although not so well developed as in the type species. The operculum is absent, but pigmented eyes are present.

In the Antarctic *Pontiothauma ergata* Hedley, 1916, eyes are present on distal ledges of short stout cephalic tentacles, there is also a moderate sized muzzle, a leaf-shaped operculum with a terminal nucleus, and a toxoglossate radula of long slender paired marginals, double barbed at the tip. The protoconch, however, is paucispiral, smooth and papillate of  $1\frac{1}{2}$  whorls.

Unfortunately the nuclear characters of the type species are unknown, so it is uncertain if the somewhat fluctuating characters in the species here grouped are indicative of one genus, or of several genera, but it is conclusive that the sum of characters of each group points exclusively to the Daphnellinae.

The genus resembles *Spergo* Dall, 1895, the chief difference being that Dall's genus has a more definite daphnellid sinus, which is accentuated in depth by a great forward swing of the outer lip.

For a very detailed account of the anatomy of *mirabile* and *abyssicola*, see Pace (1903, *Proc. Linn. Soc.* 28, pp. 455-462). Range — The deep water basins of the Indian Ocean, Bay of Bengal, southern India and Ceylon, 700-1250 fathoms; also Antarctica, 177-300 metres.

#### CHARACTERISTIC SPECIES—

*abyssicola* Smith, 1895, *ergata* Hedley, 1916, *minus* Smith, 1906, *mirabile* Smith, 1895 and *pacei* Smith, 1906.

Genus SPERGO Dall, 1895,

*Proc. U.S. Nat. Mus.* 17, p. 680. Type (s.d. Dall) 1918) *Spergo glandiniformis* Dall, 1895.

Plate 22, figs. 9, 10

Shell very large, up to 90 mm., relatively thin and almost devoid of sculpture. Typically, elongate-subcylindrical, with a tall spire and a long narrow body-whorl, gradually tapered to a short unnotched spout-like anterior canal. Protoconch of  $3\frac{1}{2}$  diagonally cancellated whorls. Adult whorls weakly more or less medially bluntly carinated, a few short oblique weak axials on the carina of the early whorls but soon becoming obsolete. Aperture long and narrow. Outer lip thin, the sinus descending almost straight and at right angles to the suture, then at the carina or angulation it suddenly swings forward in a great arc, far past the origin of the sinus above. Colour dull white, covered by a thin periostracum, which varies from pale yellowish to pinkish-brown. Interior of aperture and columella porcellaneous white. Animal with the muzzle formed by a stout squarely truncated rostrum opening into a capacious pharynx, provided internally with a degenerate proboscis not capable of extension beyond the oral orifice, with a poison gland and a degenerate radula. Eyes present and functional; tentacles low-seated, stout and clavate; operculum absent (Dall.). The radula (text fig. F168) consists of a pair of short awl-shaped marginals without barbs. Range — Recent, off Hawaii in 298-375 fathoms, off southern Japan in 100-150 fathoms, and in the Miocene-Pliocene of Okinawa.

#### CHARACTERISTIC SPECIES—

Recent — *daphnelloides* Dall, 1895, *fusiforme* (Kuroda & Habe, 1961), *glandiformis* Dall, 1895. Miocene — Pliocene — *fuscus* Mac Neil, 1960.

The Okinawan fossil differs from the Recent species in having moderately strong axials, and



spiral lirae over the lower part of the whorls. However, it seems to belong here rather than to *Pontiothauma*, which has an almost obsolete sinus. *Spergo sibogae* Schepman, 1913, from the Banda Sea in 560 metres, may belong here as a relative of *fusus*, or it may be a *Comitas*.

Subgenus *SPEOIDES* Kuroda & Habe, 1961 (of *Spergo*),

in Habe, Coloured Illust. Shells of Japan 2, p. 77 (pl. 38, fig. 17, and appendix, p. 29). Type (monotypy) *Speoides yoshidai* Kuroda & Habe, 1961.

Plate 22, figs. 11, 12

It is doubtful if this group, described as a full genus, merits even subgeneric differentiation from *Spergo*. The type species is much smaller than the type of *Spergo*, 40-45 mm., is very slender, has a nodulose carina throughout and regular dense fine lirations over the whole of the post-embryonic whorls, but otherwise the essential features of protoconch and sinus are identical with those of the typical genus. Range — Recorded from off Japan. There is a specimen from 200 fathoms off Tosa, Shikoku Island, Japan, in the United States National Museum, and others from "Albatross" Sta. 5283, from off Cape Santiago, Luzon, Philippines in 280 fathoms.

Genus *SURCULINA* Dall, 1908,

Bull. Mus. Comp. Zool. 43 (6), p. 260. Type (o.d.) *Daphnella (Surculina) blanda* Dall, 1908.

Plate 22, fig. 7

Shell of moderate size, 26-43 mm., thin, elongate-fusiform, with a moderately tall spire of rounded whorls and a narrow, rounded body-whorl, gently contracted to a long relatively straight unnotched anterior canal. Protoconch unknown. Adult whorls densely sculptured with even spiral lirae; a few feeble axials on the first 2-3 post-embryonic whorls, and faint axial growth lines, which thicken slightly towards the suture. Outer lip thin; sinus sutural, obsolescent. Operculum absent.

Dall mentioned that in a second species, *cortezii* (unfigured), which he attributed to the genus, the animal lacked eyes, tentacles and muzzle, but the retractile proboscis was large and rather long. Range — The type species is from off Cocos Island, Gulf of Panama in 1067 fathoms, and *cortezii* is from off Cortez Bank in 984 fathoms and off San Diego, California in 639 fathoms.

CHARACTERISTIC SPECIES—  
*blanda* and *cortezii* Dall, 1908.

Genus *PHANDELLA*, Casey, 1903,

Proc. Acad. Nat. Sci. Phil. p. 272. Type (o.d.) *Phandella nepionica* Casey, 1903.

Plate 22, fig. 6

Shell minute, 2.25 mm., of which one third the total height consists of a tall conical proto-

conch of 5 or 6 diagonally cancellated whorls. The post-embryonic whorls number 1½ only, sculptured with rather distant long fold-like axials, which do not reach the suture and rapidly fade out over the base. Surface smooth and devoid of spiral sculpture. Sinus sutural, moderate. Range — Known only by the type species which is from the upper Vicksburg marls, Oligocene of Mississippi, but Casey referred to two other undescribed species.

Despite the disproportionately large protoconch, the genus is apparently adult, for Casey recorded many specimens from the original locality, none of which exceeded the size of his type specimen.

Genus *EXOMILUS* Hedley, 1918,

Journ. Roy. Soc. N.S.W. 51, p. M79. Type (o.d.) *Mangelia lutraria* Hedley, 1907.

Plate 22, fig. 13

Shell small, 3-5.7 mm., subcylindrical with biangulate whorls, peripheral angle high, at about three fourths whorl height; second angle encircling the body-whorl, emergent from just below the suture. Sculpture coarsely clathrate. Protoconch of 2½-3 whorls, flattened on top, cap-shaped, second whorl convex-sided, overhanging the third, which is narrowly cylindrical, smooth except for minute crenulations at the angulate periphery of the first whorl. Aperture narrowly rectangular with a heavily variced outer lip. Sinus moderately excavated, sub-sutural. Anterior canal very short and broadly shallowly notched. Range — Recent, South Australia and Tasmania to North Queensland in 5-110 fathoms.

CHARACTERISTIC SPECIES—

*anxius* (Hedley, 1909); *cancellatus* (Beddome, 1882); *cylindricus* Laseron, 1954; *lutrarius* (Hedley, 1907); *pentagonalis* and *telescopialis* (Verco, 1896).

NOTE: *Exomilopsis* Powell, 1964, referred to the Columbelloidea, was proposed for *spica* (Hedley, 1907) and other Recent and Tertiary Australian species previously included in *Exomilus*.

Genus *PSEUDEXOMILUS* Powell, 1944,

Rec. Auck. Inst. Mus. 3 (1), p. 61. Type (o.d.) *Pseudexomilus caelatus* Powell, 1944.

Plate 22, fig. 14

Shell rather small, 11.6 mm., tall-spined, Terebra-like, with tall slender rather flat-sided whorls and a truncated anterior end, with a small ovate-quadrate aperture, produced below into a very short unnotched anterior canal. Protoconch relatively large, bluntly rounded of 2½ whorls, tip smooth, following whorls much larger, strongly convex and boldly radially ribbed. Adult whorls with strong flat-topped sharply raised wavy cords, crossed by subobsolescent axials. Sinus descending obliquely and recurrently from the suture, more or less straight, but narrowly rounded at the apex,



before descending obliquely forward below a weakly defined shoulder angle. Range — Recent and lower mid Pliocene, South Australia.

CHARACTERISTIC SPECIES—

Pliocene — *caelatus* Powell, 1944. Recent — *costicapitata* (Verco, 1909).

Genus RUGOBELA Finlay, 1924,

Trans. N.Z. Inst. 55, p. 514. Type (o.d.) *Ptychatractus tenuiliratus* Suter, 1917.

Plate 22, fig. 15

Shell rather small, 5–17 mm., elongately ovate-fusiform, resembling *Daphnella* in general facies, but with a very different protoconch, which is narrowly conic, of four to five smooth whorls, without diagonal cancellations. The sinus is almost obsolete, just a shallow broad notch, almost vertically descending, after which the thin outer lip is produced forwards in a broad arc. A characteristic of the genus is the presence of several weak plications near the base of the pillar, and this feature, to a lesser degree, is found also in *Daphnella*. Adult sculpture of weak to relatively strong axial folds and subsidiary spirals. Range — Eocene to Miocene of New Zealand, Oligocene of Tasmania and Oligocene to Miocene of Victoria.

CHARACTERISTIC SPECIES—

NEW ZEALAND: Eocene — *humerosa* (Marwick, 1926); *oborni* Marwick, 1960. Oligocene — *canaliculata* and *infelix* (Suter, 1917); *nodulosa* Powell, 1942; *semilaevigata* Laws, 1935; *sepilibilis* (Powell & Bartrum, 1929); *tenuicostata* Laws, 1935; *tenuiliratus* (Suter, 1917) (= *varicostata* Marshall & Murdoch, 1921). Miocene — *tersa* (Marwick, 1931). TASMANIA: Oligocene — *columbelloides* (Tenison-Woods, 1877) (= *marginata* Tenison-Woods, 1877). VICTORIA: Oligocene — *exsculpta* Powell, 1944. Miocene — *conospira* (Tate, 1898).

Genus TELEOCHILUS Harris, 1897,

Cat. Tert. Moll. Brit. Mus., Pt. 1, p. 64. Type (o.d.) *Daphnella gracillima* Tenison-Woods, 1877 = *Litachilus* Powell, 1944, Rec. Auck. Inst. Mus. 3 (1), p. 64. Type (o.d.) *Teleochilus royanus* Iredale, 1924.

Plate 22, figs. 16, 17

Shell of moderate size, up to 30 mm., ovate elongate-cylindrical, solid, with a long aperture. Protoconch paucispiral, blunt of  $1\frac{1}{2}$  depressed whorls, sculptured with spiral lirae, which are either smooth or minutely granulated by very slight axial threads. Sinus a minute sutural indentation. Adult sculpture of prominent spirals and a few obscure axials on the early whorls. Outer lip relatively thin; inner lip with a few faint oblique pillar plications. The subfamily location is uncertain but the pillar plications are similar to those in some species of *Daphnella*. Range — Recent; New South Wales and Victoria. Miocene and Oligocene; Victoria and Tasmania.

NOTE. *Litachilus* was proposed upon the grounds that the Recent *royanus* had the nuclear lirations granulate as opposed to smooth, as in the Tertiary *Teleochilus*. Laseron (1954, Handb. Roy. Zool. Soc. N.S.W., p. 22) sug-

gested that the slightest wear removes the granulations, and therefore granulation could have been present in the fossil species as well. In any case such a small difference does not justify the acceptance of another genus within such a compact assemblage. Laseron (l.c.) also referred *Teleochilus* to the Borsoniinae, but on account of the slight and very oblique nature of the pillar plications my original location in the Daphnellinae is preferred.

CHARACTERISTIC SPECIES—

Recent — *royanus* Iredale, 1924. Miocene — *balcombensis*, *denseliratus* and *duplicatus* Powell, 1944. Oligocene — *comptus* Powell, 1944; *gracillimus* (Tenison-Woods, 1877).

Genus SYNGENOCHILUS Powell, 1944,

Rec. Auck. Inst. Mus. 3 (1), p. 66. Type (o.d.) *Syngenchilus radiapex* Powell, 1944.

Plate 22, fig. 18

A small ovate shell, up to 7.25 mm., similar to *Teleochilus* but with a shorter and smaller aperture. Protoconch large, blunt, dome-shaped, of two whorls, first smooth, second axially costate. Adult sculpture of prominent axials, crossed by crisp narrow spiral cords. Range — Known only by the type species from the Oligocene of Torquay, Victoria, Australia.

Genus DAPHNOBELA Cossmann, 1896,

Essais Pal. Comp. 2, p. 93. Type (o.d.) *Buccinum junceum* J. de C. Sowerby, 1822.

Plate 22, fig. 19

Dall (1918, Proc. U.S. Nat. Mus. 54, p. 325) remarked that this shell was "extremely like *Aesopus*", and Woodring also (1928, Carnegie Inst. Wash. publ. no. 385, p. 287) concurred in referring the genus to the Columbelloidea.

Shell of moderate size, up to 23 mm., rather thin, narrowly subcylindrical, and sculptured with numerous fine crisp spiral cords, crossed irregularly by numerous weak somewhat uneven axial threads. These, according to their strength, render portions of the shell weakly clathrate, mostly on the earlier spire whorls. A single or double cord submargins the suture, after which there is a narrow sulcus, comparable with a sinus fasciole. Aperture narrowly ovate-pyriform. Outer lip thin, slightly concave over the shoulder sulcus area, then curved gently forward in a moderately broadly rounded arc. The protoconch appears to be narrowly conical of about three smooth whorls. Range — The genus is known by one species from the Bartonian Eocene of England.

The presence of a distinct shoulder sulcus suggests that the genus actually may be a turrid. The Australian Oligocene — Recent *Teleochilus* is somewhat similar, but has even less of a sinus than *Daphnobela*.

Genus BATHYCLIONELLA Kobelt, 1905,

Monogr. Schalent. Europ. Meeresconch. 3, p. 279. Type (monotypy) *Pleurotoma (Clionella) quadruplex* Watson, 1882. Syn *Cryptomitra* Dall, 1924, Proc.



Biol. Soc. Washington, 37, p. 89. Type (o.d.) *Pleurotomella climacella* Dall, 1895.

Plate 22, fig. 20

Shell of moderate size to rather large, up to 48 mm., narrowly cylindrical, with a tall tabulated spire of loosely wound, high shouldered whorls, with flattened sides, and a short narrow body-whorl, truncated anteriorly. Protoconch rather large of  $1\frac{1}{2}$  smooth whorls, with the tip asymmetric (*brachytoma*). Aperture narrow, parallel sided, and terminated in a short slightly flexed and weakly notched anterior canal. Outer lip thin, without indication of a sinus; inner lip a plain callus without plicae or processes of any kind, in the adult, but Dall (l.c.) noted that obsolete plaits were present on the pillar in the early whorls of his *Cryptomitra*. Adult whorls with a narrow subsutural margining, crenulated by short axial plicae, a concave shoulder slope with weak axial and spiral threads, then prominent vertical narrowly crested axials, which commence strongly at the shoulder angle and finally fade out over the upper base; the whole overridden by spiral lirae. Range — Recent in the deep ocean basins of Azores, Zanzibar, Timor Sea and Hawaiian Islands in 250-1000 fathoms.

It is doubtful if the genus is really turrid, since there is no semblance of a sinus but on the other hand, the presence of obsolete pillar plications in the early stages suggests a possible relationship with *Teleocheilus*, a genus with an almost non-existent sinus but presumed to be daphnellid on the evidence of pillar plications.

CHARACTERISTIC SPECIES—

*brachytoma* (Schepman, 1913), *climacella* (Dall, 1895), *paschalis* (Thiele, 1925) and *quadruplex* (Watson, 1882).

**Subfamily THATCHERIINAE Powell, 1942**

(emended to subfamily rank, Charig, 1963)

A group of large, deep-water, thin-shelled genera from the Mediterranean Basin and Western Pacific, Japan to New Zealand, with a time range back to the upper Oligocene.

The Thatcheriinae and Daphnellinae are the only two turrid subfamilies with a diagonally cancellated sinusigerid protoconch. From the Daphnellinae, the Thatcheriinae are distinguished mainly by the form of the sinus, which is very deep, but not strictly sutural, as it is in the first mentioned subfamily.

The sinus in the Thatcheriinae is drawn forward suturally before reaching its narrowly rounded apex, after which there is a great forward arcuate swing of the lower edge to meet the sharp peripheral carina. In the Daphnellinae the sinus descends vertically from the suture, after which, it normally swings forward tangentially, so that in profile it resembles a reversed letter L.

Some daphnellids have a parietal tubercle, and in such the sinus, consequently, is drawn

forward slightly at the suture, but in the Thatcheriinae there is no parietal tubercle to account for its drawn-forward sinus.

In 1942, when the Thatcheriidae was proposed, both the protoconch and the radula were unknown, but since then Kuroda and Habe (1954, *Venus*, 18, 2, p. 82) have shown that *Thatcheria* has a diagonally cancellated protoconch, and that the radula consists of a pair of dagger-shaped marginals, somewhat of daphnellid affinity. Because of these daphnellid similarities, Charig (1963, *Bull. Brit. Mus. Nat. Hist., Geol.*, 7, 9, p. 291) reduced the Thatcheriidae to subfamily status.

To sum up, the Thatcheriinae is considered sufficiently far removed from the Daphnellinae to maintain separate status, by having a distinctive sinus, which is not of the normal reversed L-type, and a different form of radula, which lacks the medial constriction of the dagger-shaped marginals, and further, has the addition of distally projecting basal plates. The shell is distinctive also, in being large, capacious and thin, with strongly carinated almost smooth whorls.

The subfamily includes only three groups — genus *Thatcheria*, Recent from Japan, Pliocene from Japan, Borneo, Fiji and New Zealand, and Miocene from the Celebes, subgenus *Waitara*, Miocene of New Zealand — and genus *Clinura*, lower Miocene to upper Pliocene of Europe, Miocene of the East Indies and Oligocene of New Zealand.

**Genus THATCHERIA Angas, 1877,**

*Proc. Zool. Soc.* p. 529. Type (monotypy) *Thatcheria mirabilis* Angas, 1877. Syn. *Cochlioconus* Yokoyama, 1928, *Journ. Fac. Sci. Tokyo Univ.* 2, 2, p. 338. Type (monotypy) *Cochlioconus gradatus* Yokoyama, 1928.

Plate 23, figs. 2-4

Shell very large, 70-110 mm., rather thin, broadly fusiform-biconic, with a conspicuously pagodiform spire, the sharp smooth carina at above middle whorl height, which results in a broad flat gently sloping shoulder area. Base gradually contracted to a narrow and unnotched anterior end. Surface almost smooth, sculptured with numerous very fine spiral lirations. Sinus deep, curved backward from the suture to the narrowly rounded apex, which is high on the shoulder slope, then runs obliquely forward away past its point of origin above, before merging with the carina, which in turn is confluent with a considerable forward swing of the outer lip. Protoconch narrowly conical, consisting of  $2\frac{1}{2}$  diagonally cancellated whorls, followed by about  $1\frac{1}{2}$  whorls of strongly protractive closely-spaced thin axial riblets. Radula (text fig. F169) of a pair of marginals only, consisting of a simple narrow pointed tooth with a narrow rectangular basal plate, projecting on the distal side. The operculum appears to be absent. Range — Recent, Japan,



Pliocene of Japan, Borneo, Fiji and New Zealand, Miocene of the Celebes.

CHARACTERISTIC SPECIES—

Recent — *mirabilis* (Angas, 1877). Pliocene, JAPAN, *gradata* (Yokoyama, 1928); FIJI *vitiensis* Charig, 1963; NEW ZEALAND, *liratula* and *pagodula* (Powell, 1942), Miocene — CELEBES, *carinata* (Martin, 1933).

Subgenus WAITARA Marwick, 1931 (of *Thatcheria*),

N.Z. Geol. Surv. Pal. Bull. 13, p. 149. Type (o.d.) *Turricula waitaraensis* Marwick, 1926.

Plate 23, fig. 5

Shell large, estimated 65 mm., pagodiform, whorls medially sharply angled, without trace of crenulations on the carina. Body-whorl long and narrow. Sculpture of weak spiral threads with wide interspaces, each containing a secondary spiral. Sinus as in *Thatcheria*, deeply notched, with a rounded apex, its lower margin confluent with a considerable forward swing of the outer lip.

The status of *Waitara* is doubtful, except that the sinus clearly indicates it as a member of the *Clinura-Thatcheria* group. Charig (1963, Bull. Brit. Mus. Nat. Hist., Geol. 7, 9, p. 291), provisionally referred *Waitara* to *Clinura* but with the remark that it "may still represent a distinct genus".

Unfortunately the unique type of *Waitara* is a very incomplete specimen, minus both the top of the spire and the anterior end. However, upon the available evidence, *Waitara*, by its smooth carina, would appear to have closer relationship with *Thatcheria* than with *Clinura*. On the other hand Marwick's second species, *Waitara generosa* Marwick, 1931, has weak tubercles on the early whorls and may be a *Clinura*, as claimed by Charig.

Two New Zealand Pliocene species attributed to *Waitara*, *liratula* and *pagodula* Powell, 1942, have been correctly transferred to *Thatcheria* by Charig. The Recent New Zealand *Waitara pikei* Dell, 1963 (Trans. Roy. Soc. N.Z., Zool. 3, 20, p. 215) is a *Leucosyrinx*. Range — The type species is from NZGS loc. 1148, upper Miocene, Waitara Survey District, Taranaki, New Zealand.

Genus CLINURA Bellardi, 1875,

Boll. Soc. malacol. ital. Pisa, 1, p. 20. Type (s.d. Bellardi, 1878) *Murex (Pleurotoma) calliope* Brocchi, 1814.

Plate 23, fig. 1

Shell of moderate size, 11-50 mm., rather thin, fusiform-biconic, with a moderate pagodiform spire, the rim-like submedian carina crenulated to some degree. Protoconch polygyrate, narrowly conical and diagonally cancellated. Sinus as in *Thatcheria*, narrowly rounded at the apex, which is just below the suture, then greatly produced forward below to meet the peripheral carina. Spiral sculpture of relatively strong cords from the periphery

downward; only weak spirals above the periphery on the lower shoulder slope. Base contracted to a relatively short unnotched anterior canal. Range — Lower Miocene to lower Pliocene of Europe, Miocene of the East Indies and upper Oligocene of New Zealand.

The earliest known *Clinura* seems to be the New Zealand upper Oligocene *generosa*. *Clinura anassa* Murphy & Rodda (1960, Journ. Paleont. 34 (5), p. 845) from the Cretaceous of California is not that genus but more likely a forerunner of *Turricula*.

CHARACTERISTIC SPECIES—

Pliocene — EUROPE, *calliope* (Brocchi, 1814), *sabatorum* Bellardi, 1877; Miocene — EUROPE, *calliope* (Brocchi, 1814), *controversa* (Bellardi, 1847), *sopronensis* (Wolf, 1870), *subtrochlearis* (Friedberg, 1912), *trochlearis* (M. Hörnes, 1854); CELEBES, *bituminata* (Beets, 1943). Oligocene — NEW ZEALAND, *generosa* (Marwick, 1931).

GENERA CONSIDERED TO BE DOUBTFULLY TURRID

Genus BEISSELIA Holzapfel, 1889, Palaeontogr. 35, p. 257; nom. nov. pro *Koenenia* Holzapfel, 1888, Palaeontogr. 34, p. 91 (non Beuschausen, 1884). Type (monotypy) *Koenenia speciosa* Holzapfel, 1888.

Plate 23, figs. 6, 7

This is a Cretaceous genus, based upon an incomplete specimen of about 46 mm. in height, which is minus both the upper spire whorls and the anterior canal. It was compared with *Pholidotoma* by Cossmann (1896, Essais Pal. Comp. 2, p. 113), but that genus was considered to be Volutid by Dall (1918, Proc. U.S. Nat. Mus. 54, p. 330). The unique type specimen has strongly convex whorls, sculptured with heavy rounded axials, overridden by prominent spiral cords. According to Holzapfel's carefully drawn figures, the sinus is shown to be sutural and quite deep at its inception, but then swinging forward convexly, high up on the shoulder slope, to again retreat as a pseudosinus, just above the peripheral angle.

If this genus is turrid, which is doubtful, then its relationship is likely to be with the Daphnellinae. Range — Known only by the type species which is from the Senonian, Cretaceous of Aix-la-Chapelle, Germany.

Genus DAPHNELLOPSIS Schepman, 1913,

Siboga Exped. Monog. 49, 1e, p. 85. Type (o.d.) *Daphnellopsis lamellosa* Schepman, 1913.

Plate 23, figs. 16, 17

This is a problematic genus; Schepman referred it with some reservation to the Turridae, in the vicinity of *Daphnella*, but Iredale (1918, Proc. Malac. Soc. 13, p. 33) considered the genus to be related to *Maculotriton*, which Thiele (1929, Handb. Syst. Weicht., 1, p. 293) placed in the Muricidae, but the generally accepted location of *Maculotriton* is in the Colubrariidae. Hedley, however, (1922, Rec.



Austr. Mus. 13, p. 356) preferred the Turridae for *Daphnellopsis*, described another species of the genus, and referred to *Clathurella obesa* Garrett, 1873, a Fijian species, as a probable third member; this latter inclusion, however, has a normal turrid sinus and is most likely a *Philbertia*.

Shell small, 5-9 mm., white, elongate-ovate, conspicuously sculptured with frilled axial lamellae, overriding spiral cords. The labial varix is broad-faced but with a thin outer edge that curves backward in a double frilled margin. The sinus in the type species is a broad sub-sutural excavation with a thin reflected outer edge. In Hedley's species, *murex*, the sinus is decidedly subtubular. Range — Savu Sea 274 metres (Schepman), Murray Island, 5-8 fathoms, Queensland (Hedley) Sandakan, Borneo, 34 fathoms, and several Philippine localities in 145-153 fathoms ("Albatross" Exped.).

#### CHARACTERISTIC SPECIES—

*lamellosa* Schepman, 1913, *murex* Hedley, 1922.

No turrid sinus is quite like that of *Daphnellopsis*, and the style of sculpture is decidedly muricid. Also, there appears to be no relationship between this genus and *Maculotriton*. Only recourse to study of the animal will solve the family location of *Daphnellopsis*. Dr Myra Keen informs me that there are preserved animals in the Zoological Museum, Amsterdam.

Genus EOTHESBIA Finlay & Marwick, 1937, N.Z. Geol. Surv. Palaeont. Bull. 15, p. 88. Type (o.d.) *Eothesbia microtomoides* Finlay & Marwick, 1937.

#### Plate 23, fig 18

Shell small, 9 mm., fusiform, with a tall spire of lightly convex whorls, but body-whorl rather inflated, also rounded, but quickly contracted over the base to a gently twisted neck and moderately long unnotched anterior canal. Protoconch conoidal, smooth, of about 4½ whorls, with a small nucleus. Adult sculpture of regular closely spaced flat-topped spiral threads with deep narrow interspaces. No axial sculpture other than fine regular growth lines. Sinus very broadly arcuate, extending from the suture to just below the periphery. Compared with *Thesbia* by its authors but that genus has a narrower sinus and the protoconch is paucispiral and globular. The subfamily location is uncertain as also is its possible relationship to *Thesbia*. Range — Known only by the type species, which is from the Paleocene of Wanga-loa, New Zealand.

Genus EXILIA Conrad, 1860,

Journ. Acad. Nat. Sci. Phil. 2, 4, p. 291. Type (monotypy) *Exilia pergracilis* Conrad, 1860.

#### Plate 23, fig. 22

Shell rather small, very narrowly fusiform, with a tall narrow spire of lightly convex

whorls and a long very narrow body-whorl, slowly tapered to a long straight unnotched anterior canal. Spire slightly taller than the aperture plus the canal. Whorls about 12, including a small protoconch of two smooth whorls. Sculpture of numerous vertical, slightly flexed axial ribs, extending from suture to suture and over most of the base. Surface sculpture of fine closely spaced spiral lirae. Range — Eocene of Alabama (type) and Tejon and Domingine Eocene of California.

Stewart (1927, Proc. Acad. Nat. Sci. Phil. 78, p. 419) located the genus in the Turridae because of a faint notch in the outer lip of the type species, assumed to represent a shallow anal sinus. He also considered that the Recent species referred to *Exilia*, by Dall (1918, Proc. U.S. Nat. Mus. 54, p. 221), were in all probability neptunid.

It is doubtful, however, that even the typical members of the genus are really turrids.

#### CHARACTERISTIC SPECIES—

*diaboli* (Gabb, 1864), *fausta* Anderson & Hanna, 1925, *microptygma* (Gabb, 1864) and *pergracilis* Conrad, 1860.

Genus FUSITOMA Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, p. 163. Type (o.d.) "*Fusitoma siphon*."

#### Plate 23, fig. 15

It is uncertain from Casey's paper if *Fusitoma siphon* was intended as a new proposition, or if it was based upon *Fusus siphon* Aldrich. The final sentence of Casey's description would seem to indicate that the latter was the case — i.e. "The embryo in my single example, which I owe to the kindness of Mr Aldrich, is not in good condition". On the other hand, a specimen in the Casey collection at the United States National Museum is labelled "*Fusitoma siphon* Casey, TYPE", and its description is as follows—

Shell of moderate size, 24 mm., fusiform, with a tall spire of lightly rounded whorls, weakly shouldered at about two thirds whorl height. The protoconch is not well preserved, but is paucispiral and apparently smooth. Adult sculpture of dense sharp axials, crossed by equally dense spirals, the axials slightly the stronger. Anterior canal short, with a spout-like termination. Outer lip weakly sigmoid in profile, the sinus a broad, shallow, subsutural concavity.

The genus has a superficial resemblance to the Recent *Surculina blanda* Dall, 1908, from 1067 fathoms, Gulf of Panama, but has a much shorter anterior canal, the sinus is scarcely daphnellid, and the protoconch is atypical for that subfamily; it may not even belong to the Turridae. Range — Casey did not state either locality or horizon for his genus, other than inferring that it was from the southeastern American Eocene.



Genus *HETEROTERMA* Gabb, 1868, Geol. Surv. Calif. Pal. 2, p. 151. Type (monotypy) *Heteroterma trochoidea* Gabb, 1868.

The family position of *Heteroterma* is still in doubt. Cossmann (1901, Essais Pal. Comp. 4) synonymised it with *Tudicla*, but Stewart (1927, Proc. Acad. Nat. Sci. Phil. 78, p. 423) and Finlay & Marwick (1937, N.Z. Geol. Surv. Pal. Bull. 15, p. 84) considered it distinct and referred the genus back to Gabb's original location in the *Turridae*. The genus has a broad shallow posterior sinus, not definitely turrid; in fact many members of the Fascioliidae, Buccinidae and Neptuniidae are similarly broadly and shallowly sinused.

The New Zealand Paleocene *Heteroterma zelandica* (Marshall, 1917) certainly recalls the Tudicidae in general facies, but it lacks the characteristic obliquely transverse pillar plait. There is, however, a slight thickening and ridging of the inner columellar margin similar to that found in some of the Fascioliidae, and for that reason, as well as the absence of convincing turrid features I am inclined to revert to Cossmann's placing of *Heteroterma* in the Tudicinae, which Finlay & Marwick arised to family rank. *Heteroterma* is typically from the Californian Paleocene, has a probable member in the Patagonian Cretaceous *Cominella praecursor* Wilckens, and is represented in the New Zealand Paleocene by the above mentioned *zelandica* (Marshall).

Genus *HORAICLAVUS* Oyama, 1954, Palaeont. Soc. Japan, spec. paper, no. 2, p. 52. Type (o.d.) *Mangilia splendida* A. Adams, 1867.

*Plate 23, figs. 11-13*

Although this genus resembles a clavinid in general form it is doubtful if it is really turrid, since there is no vestige of a sinus. Only recourse to study of the soft parts, at present unavailable, will determine if the genus is turrid or buccinoid.

Shell of moderate size, 14-24 mm., elongate-bucciniform, with a tall spire of lightly convex whorls and a short body-whorl, terminating in a very short widely open shallowly notched anterior canal. Protoconch subglobose of two smooth whorls, followed by a few brephic axials. Adult sculpture of narrow but distinct axials that extend from suture to suture and over the whole of the base. Interstitial sculpture of subobsolete spiral lirae. Aperture broadly ovate; outer lip thin edged but thickened behind by a heavy broadly rounded varix. Inner lip with a distinct callus, but no parietal pad, tubercles or other apertural processes. Colour whitish, maculated with reddish-brown blotches and interrupted spiral bands. An undoubted second species is Schepman's *Drillia madurensis* (1913, Siboga Exped. 49, 1e, pl. 27, fig. 4) from Madura Bay, 69-91 metres. Range — Recent, Japan (*splendida*) and Indonesia (*madurensis*). Pleistocene, Japan (*splen-*

*dida*) Shuto, 1965, Mem. Fac. Sci. Kyushu Univ., ser. D, Geol. 16, 2, p. 154.

Genus *NEKEWIS* Stewart, 1926, Proc. Acad. Nat. Sci. Phil. 78, p. 421. Type (o.d.) "*Fasciolaria*" *washingtoniana* Weaver, 1912.

This is another genus of uncertain family location. The following opinion of Wrigley (1927, Proc. Malac. Soc. 17, p. 248) sums up the situation — "This genus is placed among the Turridae, perhaps because the 'very shallow anal sulcus' at the rear of its growth lines is held to resemble that of *Surcula*. But the distinct notch of *Surcula* is quite different from the widely open arch found in the species we are discussing" (English Eocene Fusinidae). "This arch of the growth-lines always is present in fusoid shells with a marked carina and a sloping, flat or concave rear margin: many indubitable species of *Fusinus* (s.s.) have quite as distinct an arch as the genotype of *Nekewis*." Range — Tejon Eocene of California and Washington.

CHARACTERISTIC SPECIES—

*io* (Gabb, 1864) (= *ioformis* and *alizensis* Anderson & Hanna, 1925) *washingtoniana* (Weaver, 1912).

Genus *PYRAMITOMA* Martin, 1914,

Samml. Geol. Reichs-Mus. 2, 4, p. 118. Type (monotypy) *Pyramitoma puruensis* Martin, 1914.

Shell of moderate size, 21 mm., elongate-fusiform, solid, with a tall spire of rather flat outlines, and a short rather strongly convex body-whorl, quickly contracted basally to a long straight unnotched anterior canal. Sculpture of rather distant bold broadly rounded axials, which fall into longitudinal series from whorl to whorl. Aperture small, quickly contracted below to the long anterior canal; outer lip conspicuously lirate within. Sinus not apparent. Range — Known only from the Nanggulan Miocene of Java.

The genus has more the appearance of the fasciolarid genus *Latirus* than a turrid.

Genus *TRITONIMANGILIA* Martin, 1914,

Samml. Geol. Reichs-Mus. Leiden, 2, 4, p. 126. Type (monotypy) *Mangilia* (*Tritonimangilia*) *varicifera* Martin, 1914.

*Plate 23, fig. 9*

The author compared his subgenus with both *Mangilia* and *Mangiliella* but it is doubtful if the shell is really turrid, for the figure shows no semblance of a sinus, and both the protoconch and the end of the anterior canal are missing; it could equally well be buccinoid or even fasciolarid.

The shell is of moderate size, 16mm., stout, biconical, sculptured with heavy rounded axials, strongest at a subperipheral angulation, not reaching the upper suture and fading out at about the middle of the base; the whole overridden by dense spiral lirae. Range —

Known only by the type species which is from the Nanggulan Miocene of Java.

Genus VARICOBELA Casey, 1904,  
Trans. Acad. Sci. St. Louis, 14, 5, p. 162. Type  
(o.d.) *Strombus smithi* Aldrich, 1885.

Plate 23, fig. 14

I have not seen Aldrich's type specimen, which is from the Eocene of Red Bluff, Mississippi, but I examined in the United States Geological Survey collection, Washington, the specimen upon which Casey drafted his generic description. This specimen is of moderate size, 22mm.; broadly ovate-biconic, sculptured with flexuous, somewhat irregular axials, with distant stronger broadly rounded varices, which fall roughly into confluent vertical series, on opposite sides of the shell, after the fashion of those of *Bursa*. Spirals dense and weak above but becoming stronger basally. Protoconch large, broadly conical of  $2\frac{1}{2}$  whorls, followed by a reticulated whorl. There is no indication of either a sinus or a fasciole.

Aldrich's small and indistinct figure of his type specimen (1886, Bull. 1, Alabama Geol. Survey, pl. 2, fig. 6) seems to represent the same species as Casey's shell, but the genus appears to have little claim for inclusion in the Turridae, and is probably better located in the Buccinacea.

Genus ZEXILIA Finlay, 1927,  
Trans. N.Z. Inst. 57, p. 506. Type (o.d.) *Exilia waihaoensis* Suter, 1917.

This genus was proposed for a group of narrowly fusiform shells from the Eocene to Miocene of New Zealand. It was referred to the Fascioliariidae by the original author, and this association was maintained by Finlay & Marwick (1937, N.Z. Geol. Pal. Bull. 15, p. 68).

However, Wenz (1944, Handb. der Palaeozool. Gast. 8, 1, p. 1417) referred *Zexilia* to the Turridae, following *Exilia* Conrad, 1860 and *Palaeorhaphis* Stewart, 1927; *Zexilia* differs from *Exilia* mainly in the absence of pillar plications. There is a very shallow sigmoid sinus in *Zexilia* but in all probability the genus is fusinid (i.e. Fascioliariidae) rather than Turrid.

**NOMINA NUDA and  
UNAUTHENTICATED GENERA  
formerly referred to the TURRIDAE**

Genus "CORBULOSPIRA Vincent, 1913:"  
"*Surcula (Corbulospira)*" Gardener, 1931,  
Bull. Amer. Assoc. Petrol. Geol. 15, 2, p. 157.

This subgeneric name seems to have crept into literature through an erroneous citation of Gardner, in a paper entitled "Relation of certain foreign faunas to Midway Fauna of Texas", as follows — "Among the allied forms are a

small *Calyptraphorus, Surcula (Corbulospira)*, and *Clinuropsis diderrichi*".

These remarks refer to Vincent (1913, Ann. Mus. Congo Belge, Geol. Pal. Min. ser. 3, 1, 1, pp. 21-25), but the name "*Corbulospira*" does not occur. It is probably a lapsus for *Cochlespira* and should be regarded as a nomen nudum, dating from Gardner, 1931.

Genus "DIPLOCONUS Sandberger",

Dall (1918, Proc. U.S. Nat. Mus. 54, no. 2238, p. 325) made the following entry in his list of turrid genera. "*Diploconus* Sandberger (Not seen) Not *Diploconus* Haeckel (Protista), 1860, nor Candèze (Coleoptera) 1860, nor of Zittel (Cephalopoda), 1868."

I have failed to trace any other reference to "*Diploconus* Sandberger", and Neave (1939, Nomenclator Zoologicus, 2) did not list it. A further proposal of this already thrice preoccupied name is that of Douvillé (1929, Pal. Ind. Mem. Geol. Surv. India, n.s., 10, 3, p. 36). Even if "*Diploconus* Sandberger" was published it has no validity as a name and can be ignored.

Genus LORA Gisl, 1848,

Nat. Thierr., p. 9, nom. nov. pro *Defrancia* Millet, 1826 (non Bronn, 1825).

This generic name was used by Dall and others for the large series of Boreal shells now covered by *Oenopota* Mörch, *Propebela* Iredale, 1918, and a number of generic and subgeneric propositions of Bartsch (1941, Proc. Biol. Soc. Wash. 54, pp. 1-14). The earliest valid substitute name for the preoccupied *Defrancia* Millet, 1826, is *Pleurotomoides* Bronn, 1831.

Genus MELATOMA Swainson, 1840,

Treat. Malac. pp. 202, 242. Type (monotypy) *Melatoma costata* Swainson, 1840 "founded upon a remarkable Ohio shell . . . sent . . . by . . . Professor Rafinesque".

There seems to be little chance of ever finding the type specimen of this problematic genus. Dall (1918, Proc. U.S. Nat. Mus. 54, p. 317) considered that *Melatoma* was not fluviatile, as the locality (probably erroneous) suggested, but belonged to the South African genus of turrids later named *Clionella* Gray, 1847. However, Swainson's figure is not sufficiently precise to substantiate this claim as pointed out by Iredale (1918, Proc. Malac. Soc. 13, p. 33), so the only course is to consider *Melatoma* still a nomen dubium.

Group name PLEUROTOMINA (Beck?), 1847,

Deutsche Naturf. und Aerzte. Amtlicher Bericht über die 24te Versamml. in Kiel, p. 115.

This name, by an unknown author, assumed to have been Beck, was introduced in a supergeneric sense to cover all small turrids, and was not, as Dall claimed (1918, Proc. U.S.



Nat. Mus. 54, p. 330), intended as a new name for the preoccupied *Defrancia* Millet, 1826. The name *Pleurotomina* is, therefore, a nomen dubium, and for a full discussion of the problem, refer to Grant & Gale (1931, Mem. San Diego Soc. Nat. Hist. 1, pp. 512-514).

Genus PSEUDOGEEMMULA (Dall ms.) Grant & Gale, 1931,

Mem. San. Diego Soc. Nat. Hist. 1, p. 571.

This is a nomen nudum, as also is the species cited in its connection. The relevant passage from Grant & Gale (l.c.p. 571) is as follows—"Dall intended to describe a species collected off the Hawaiian Islands in 284-291 fathoms by Dr. Heath as "*Turris incilis*" and also as "*Pseudogemmula pailoloensis*", according to specimens in the Oldroyd Collection at Stanford University; but apparently he never did so".

These names are from an extensive unpublished manuscript of Dall's, copies of which are both in the United States National Museum and in the B. P. Bishop Museum, Honolulu. Unfortunately, unpublished names from this manuscript are now attached to distributed material in a number of museums.

Genus STROMBINA Gregorio, 1890,

Ann. Géol. Pal. no. 7, p. 25 (non Bronn, 1849, non Mörch, 1852). Type;? "first species *Pleurotoma stromboides* Lamarck".

Interpretations of this genus are quite diverse; Cossmann (1896, Essais Pal. Comp. 2, p. 73) made it a synonym of *Apiotoma*; Dall (1918, Proc. U.S. Nat. Mus. 54, p. 331) declared it a synonym of *Gemmula* Weinkauff, 1875, and Wenz (1943, Handb. der Pal. 6, p. 1398) indicated identity with *Eopleurotoma* Cossmann, 1889. However the main point is that *Strombina* Gregorio, 1890, is unavailable since the name is twice preoccupied.

#### GENERA EITHER PROPOSED AS TURRIDS OR SUBSEQUENTLY REFERRED TO THAT FAMILY, BUT NOW CONSIDERED TO BE NON-TURRID

Genus ANARITHMA Iredale, 1916,  
Proc. Malac. Soc. 12 (1), p. 28. Type (o.d.) *Clavatulula metula* Hinds, 1843.

Wenz (1938-44, Handb. Palaeozool 6, 1, p. 1428) included this genus in the Turridae, despite the fact that Iredale (l.c.) discussed the situation at considerable length, convincingly claiming the genus to be Columbelloid.

Genus ANNA Risso, 1826,

Hist. Nat. Europe, 4, p. 214. Type (Dall, 1918) *Anna massena* Risso, 1826.

Referred to the Turridae by some, but now considered to be a *Cantharus*, according to Dall (1918, Proc. U.S. Nat. Mus., 54, p. 322).

Genus CHAUVETIA Monterosato, 1884,  
Nomenc. Gen. Spec. Conch. Medit., p. 137; nom. nov. pro *Nesaea* Risso, 1826 (non Leach, 1814). Type "*Buccinum candidissima* Philippi".

Dall (1918, Proc. U.S. Nat. Mus. 54, p. 323) included this genus in his list of turrid genera, citing Monterosato (1890), who referred it to the group of *Raphitoma vulpecula* (Brocchi, 1814). However, Dall remarked that the type species, *candidissima*, appears to be a cancellate *Anachis*.

Genus COLUMBARIUM Martens, 1881,  
Conch. Mittheil. 2, p. 105. Type (monotypy) *Pleurotoma spinicincta* Martens, 1881.

This genus has been included in the Turridae by many authors, largely upon the statement of Schacko (1881, Conch. Mittheil. 2, p. 122), who described the radula of *spinicincta* as consisting of two blunt, dagger-shaped teeth, not unlike those of *Defrancia*. Peile, however, (1922, Proc. Malac. Soc. 15 (1), pp. 13, 14) suggested that the objects figured by Schacko were the limbs of crustacea, or some such remains, associated with the body of the mollusc, which was admittedly badly preserved. At the same time Peile provided an authentic radula illustration for *pagoda* (Lesson), a near relative of the type species and this shows conclusively that *Columbarium* is rachioglossate and a member of the Muricea.

Genus CYMAKRA Gardner, 1937,  
U.S. Geol. Surv. Prof. Paper 142 F, p. 421. Type (o.d.) *Cymakra ponci* Gardner, 1937.

Shell small, 6.5 mm., narrowly biconically ovate. Protoconch small, smooth, obtuse and paucispiral. Adult sculpture of strong linear spaced spiral cords, the early whorls axially folded. Aperture narrow. Outer lip thin edged, but lirate within. Inner lip with two narrow but distinct oblique plaits. No posterior sinus. Range — The Miocene and Pliocene of Florida.

Wenz (1943, Handb. der Pal. 6, p. 1430) included *Cymakra* with a query, in the Turridae, associated with *Mitromorpha*, *Mitrolumna* and *Helenella*, but the entire absence of an anal sinus induces one to prefer Gardner's original location of the genus in the Mitridae.

Genus DONOVANIA Bucquoy, Dautzenberg & Dollfus, 1883,

Les Mollusques marins du Roussillon 4, p. 112. Type (o.d.) *Buccinum minimum* Montagu, 1803=*Buccinum brunneum* Donovan, 1804 (non *Donovania* Leach, 1814), see *Syntagma* Iredale, 1918 (nom. nov. pro *Donovania* B.D. & D., 1883).

This name was included in Dall's list of turrid genera (1918, Proc. U.S. Nat. Mus. 54, p. 325) but Iredale (1918, Proc. Malac. Soc. 13, pp. 34, 35) pointed out that the radula is buccinoid.

Genus DRILLUTA Wade, 1916,

Proc. Acad. Nat. Sci. Phil. 68, p. 458. Type (o.d.) *Drilluta communis* Wade, 1916. Syn. *Drilliovoluta*



Cossmann, 1925, *Essais*. Pal. Comp. 13, p. 244 (an unnecessary emendation).

The author of this genus considered it to be volutid, but Wenz (1938-44, *Handb. Palaeozool.* 6, 1, p. 1418) referred it with a query to the *Turridae*. However its present, more satisfactory resting place is in the *Fascioliidae* (Sohl, 1964, U.S. Geol. Surv. Prof. Paper 331B, p. 205). The genus is from the upper Cretaceous of the Southern United States.

#### Genus FOLINEAEA Monterosato, 1884

Nomen, Gen. Spec. Conch. Medit. p. 136. Type (virtual tautonymy, and s.d. Dall, 1918) "*Buccinum lefebvrei* Maravigna, 1840 + *B. folineaea* Philippi". A synonym of *Chauvetia* Monterosato. 1884 = *Donovania* Bucquoy, Dautzenberg and Dollfus. 1883 (non Leach, 1814), according to Cossmann (1896, *Essais* Pal. Comp., p. 94 and Grant & Gale (1931, *Mem. San Diego Soc. Nat. Hist.* 1, p. 686).

#### Genus KRYPTOS (Jeffreys, ms.) Dautzenberg & Fischer, 1896,

*Mem. Soc. Zool. France*, 9, p. 435. Type (monotypy) *Kryptos elegans* Dautzenberg & Fischer, 1896.

The type species of *Kryptos* was referred to the turrid genus *Pleurotomella* by Locard (1897, *Exped. Scient. Trav. Talisman*, Moll. Test., p. 244), and again, but under its original genus, and near to *Pleurotomella*, by Kobelt (1905, *Iconogr. Sch. europ. Meeresconchyl.*, p. 281). However, Wenz (1943, *Handb. der Pal.* 6, p. 1258), seemingly more correctly, made *Kryptos* a subgenus of *Fusinus* in the *Fascioliidae*. The type species is from the North Atlantic in 1600 to 1900 metres.

#### Genus FULGERCA Stephenson, 1941,

*Publ. Univ. Texas*, no. 4101, p. 372. Type (o.d.) *Fulgerca venusta* Stephenson, 1941.

This is a Cretaceous genus from Alabama, Tennessee and Mississippi. It was originally described as turrid, but the presence of a basal sulcus, terminating in a tooth, induced Sohl (1964, U.S. Geol. Surv. Prof. Paper 331B, p. 246) to refer the genus to the *Olividae*, subfamily *Pseudolivinae*.

#### Genus GOSAVIA Stoliczka, 1866,

S.B. Akad. Wiss. Wien. Math.-naturw. Kl., 52, 1, p. 169. Type (Cossmann, 1896) *Voluta squamosa* Zek.

As pointed out by Dall (1918, *Proc. U.S. Nat. Mus.* 54, p. 327) this genus, which is volutid, was wrongly placed in the *Turridae* by Cossmann (1896, *Essais* Pal. Comp. 2, p. 116, pl. 7, figs. 26, 27).

#### Genus MESOCHILOTOMA Seeley, 1861,

*Ann. Mag. Nat. Hist.* ser. 3, 7, p. 284. Type (monotypy) *Mesochilotoma striata* Seeley, 1861.

Dall (1918, *Proc. U.S. Nat. Mus.* 54, p. 328) stated that this genus, the type species of which is from the Cretaceous of Cambridge, England, equals *Surculites* Conrad, 1865. How-

ever, the present opinion, held by English paleontologists, confirmed by a personal examination of the type, is that it is non turrid, and probably an immature aporrhaid, so the validity of *Surculites* is not involved.

#### Genus MICHELA Gardner, 1945,

*Geol. Soc. Amer. mem.* 11, p. 230. Type (o.d.) *Levifusus trabeatoides* Harris, 1895.

#### Plate 23, fig. 23

This genus, which was described as a turrid, has little in common with that family, and would seem to be more satisfactorily placed in, or in the vicinity of, the *Fascioliidae*.

The shell is moderately large, up to about 50 mm., very broadly biconical, with a strongly biangulate body-whorl, a large quadrangular aperture, rapidly tapered to a moderately long, flexed and recurved anterior canal, and the interior of the outer lip is strongly lirate. The adult sculpture is of narrow crisp spiral cords crossed by numerous axial growth threads, which thicken into weak nodes at the peripheral carinae. The siphonal notch is described as broad and shallow.

Actually the sinus, or approximation to one, is no better developed than that of *Surculites*, which now also is considered to belong in the vicinity of the fasciolarids or buccinids. Range — Lower Claiborne of Alabama to northern Mexico.

#### Genus PALAEORHAPHIS Stewart, 1927,

*Proc. Acad. Nat. Sci. Phil.* 78, pp. 308 and 419. Type (o.d.) *Fasciolaria pergracilis* Aldrich, 1886.

#### Plate 23, fig. 22

Shell extremely long and slender, with a tall acutely tapered spire of lightly convex whorls, and a very long and narrow body-whorl, gradually tapered to a long straight unnotched anterior canal. The aperture is lanceolate, the outer lip thin, without an anal sinus, and the straight pillar bears 2 or 3 distinct but not prominent plications. The adult sculpture is strongly axially costate over the first four post nuclear whorls, after which there is a sudden change to strong linear spaced spiral cords. Range — Known only by the type species which is from the Wilcox Eocene of Alabama.

Stewart considered the genus to be turrid, but it is more likely volutid or possibly mitrid.

#### Genus PHOLIDOTOMA Cossmann, 1896,

*Essais* Pal. Comp. 2, p. 111. Type (o.d.) *Fusus subheptagonus* Orbigny, 1850.

This genus was included in the *Turridae* by Cossmann (l.c. pl. 8, fig. 15), but it is now considered to be volutid, firstly by Dall (1918, *Proc. U.S. Nat. Mus.* 54, p. 330), and then by Wenz (1943, *Handb. der Pal.* 6, p. 1317), who segregated it in a subfamily *Pholidotominae*.



Genus *PRISCOFUSUS* Conrad, 1865,  
Amer. Journ. Conch. 1, p. 150. Type (s.d. Cossmann,  
1901) *Fusus geniculus* Conrad, 1849.

Plate 23, fig. 8

This genus was introduced for six species from the Miocene of Astoria, Oregon, and attributed to the Muricidae. Cossmann (1901, Essais Pal. Comp. 4, p. 8) designated *geniculus* as type of the genus, which he assigned to the Fascioliidae. Dall (1909, U.S. Geol. Surv. Prof. Paper 59, pp. 39-41) retained *Priscofusus* in the Fascioliidae, and listed four species from the Miocene of Astoria, all of which were in Conrad's original list. He also erroneously cited *Fusus corpulentus* Conrad, 1849 as type of the genus. Grant & Gale (1931, Mem. San Diego Soc. Nat. Hist. 1, pp. 490-492) referred the genus, with some doubt, to the Turridae, associating seven species with it, of which only two, *geniculus* and *medialis*, were of Conrad's original list. They excluded *corpulentus*, claiming it to belong to the melongenid genus *Bruclarkia*.

Grant and Gale's reasons for preferring the Turridae for *Priscofusus* are not convincing, as shown by their remarks — "*Priscofusus* is characterized by its fusiform shape and by its broad, almost *Fusus*-like posterior sinuation, which takes the place of the posterior notch. It is certainly not a characteristic form of notch for the Turridae, and it is somewhat doubtful whether the genus should be placed here or with the Fascioliidae as Dall had it." Wenz (1943, Handb. der Pal. 6, p. 1391) also referred *Priscofusus* to the Turridae, placing it between *Waitara* Marwick, 1931 (Thatcheriidae) and *Speightia* (Speightiidae).

From the above it would seem that there is not a strong claim for inclusion of *Priscofusus* in the Turridae, and so retention of the genus in the Fascioliidae is preferred.

Genus *PURUIANA* Martin, 1931,

Wetens. Meded. Mijnb. Weltevreden, no. 18, p. 19. Type (o.d.) *Puruiana rustica* Martin, 1931.

Shell rather small, 14 mm., ovate-fusiform, with a narrowly conical spire of straight outlines, slightly less in height than the body-whorl plus the canal. Body-whorl elongate-ovate, slightly excavated over the neck, and tapered to a probably moderately long anterior canal (apparently broken off at the tip in the type specimen). Protoconch dome-shaped of 1½ smooth whorls. Adult whorls smooth surfaced. Suture deeply incised but not margined. Aperture narrowly ovate-pyriform. Outer lip thin (broken back in the type) and apparently without either a sinus or internal lirations. Inner lip with two medially placed conspicuous plaits, the upper one the stronger. Range — Known only by the type species which is from the Nanggulan Miocene of Kali Puru, Java.

Martin proposed *Puruiana* as a subgenus of *Mitrolumna*, but there is little resemblance to that genus; a more satisfactory location would seem to be in the Mitridae.

Genus *RHOMBOPSIS* Gardner, 1916,

Maryland Geol. Surv. Upp. Cret. p. 456, nom. nov. pro *Neptunella* Meek, 1864, Smithson. Misc. Coll. 7 (8), no. 177, p. 38 (non *Neptunella* Gray, 1853). Type (o.d.) *Fusus newberryi* Meek & Hayden, 1857.

Plate 23, fig. 10

This is a Cretaceous genus from the western interior of the United States, Mississippi and Peru. It was originally proposed as a subgenus of *Pyrifusus* Conrad, 1858, but Finlay and Marwick (1937, N.Z. Geol. Surv. Pal. Bull. 15, p. 84) suggested a possible connection of *newberryi* with such genera as *Surculites*, *Heteroterma* and *Nekewis*.

The latest opinion, however, that of Sohl (1964, U.S. Geol. Surv. Prof. Paper 331B, p. 198), placed *Rhombopsis* in the Melongenidae, next to *Pyrifusus*.

Genus *RUSCULA* Casey, 1904,

Trans. Acad. Sci. St. Louis, 14, 5, p. 161. Type (o.d.) *Fusus plicata* (Lea, 1833) = *Fasciolaria plicata* Lea, 1833.

This belongs to the fasciolarid genus *Latirus*, according to Palmer (1937, Bull. Amer. Paleont. 7, p. 343) and Wenz (1943, Handb. der Pal. 6, p. 1241). The type species is from the upper Claiborne ferruginous sand of the southeastern United States.

Genus *SAVATIERIA* Rochebrune & Mabilie, 1885,

Bull. Soc. philom. Paris, 7, 9, p. 101. Type (monotypy) *Savatieria frigida* Rochebrune & Mabilie, 1885.

This Magellanic genus was described as a turrid but its true location seems to be in the Buccinacea.

Genus *SURCULITES* Conrad, 1865,

Amer. Journ. Conch. 1, p. 213. Type (monotypy) *Surcula* (*Surculites*) *annosa* Conrad, 1865.

Plate 23, figs. 19, 20

The type species of the genus came from the Eocene of Shark River, New Jersey, and is an internal cast, the apparent sutural fold shown in Conrad's figure (pl. 20, fig. 9) being an adventitious feature resulting from the weathering away of the shell substance.

A better known and usually well preserved representative of this genus is the English Bartonian Eocene *Surculites errans* (Solander, 1766).

However, Wrigley (1939, Proc. Malac. Soc. 23 (5), pp. 277-284), who discussed the genus at length, came to the conclusion that the broadly concavely arcuate trend of the outer lip from the suture to the shoulder angle, in *Surculites*, could not be construed as a turrid

sinus, and therefore assigned the genus to "a not too determinate position between the *Fusini-dae* and the *Buccinidae*."

**Genus SURCULOFUSUS Vincent, 1895,**

Soc. Roy. Malac. Belg. 24 (Proc. verb.), p. CIV. Type (monotypy) *Surculofusus bruxellensis* Vincent, 1895.

Shell evidently moderately large (no size given), and broadly fusiform. There is a slight shoulder-slope concavity, scarcely a sinus, not nearly as definite as in *Speightia*, which otherwise the genus somewhat resembles. It is probably fasciolarid rather than turrid. Vincent compared his species with *Fusus serratus* Lamarck. Range — Known only by the type species which is from the Eocene of Belgium.

**Genus TURRICULINA Gregorio, 1930,**

Ann. Géol. Paléont. Palermo 53, pp. 18, 19. Type (o.d.) *Turriculina unica* Gregorio, 1930.

Although described as a turrid and listed as such in the Zoological Record, 73, p. 91, this genus, which is from the Lias of Sicily, has nothing to do with that family. Wenz (1938, Handb. Palaeozool. p. 391) placed the genus, with a query, in the family Coelostylinidae of the Loxonematacea.

**Genus UTTLEYA Marwick, 1934,**

Proc. Malac. Soc. 21, p. 19. Type (o.d.) *Utleya arcana* Marwick, 1934.

This genus was doubtfully assigned to the Turridae by its author, with the remarks that "The gently sinused outer lip and small size suggests the Turridae but a similar sinus is found in the Cominellidae (e.g. *Cominista*

*glandiformis* Reeve) and in other Buccinoid families. The concave set of the columella and inner lip, however, is unlike that of most Turrids and recalls the Thaidids and some Trophons. There is also a general resemblance to some Pyrenids."

In 1942 (Powell, Bull. 2, Auck. Inst. Mus. p. 170) mostly upon the evidence of the concave columella, the Muricidae was accepted as the most likely repository for the genus, and this was later proved to be correct, as shown by the radula of *U. williamsi* Powell, 1952 (Rec. Auck. Inst. Mus. 4 (3), pl. 36, fig. 5a).

**UNCERTAIN STATUS**

Genus CYTHAROPSIS A. Adams, 1865, Ann. Mag. Nat Hist., ser. 3, 15, p. 322. Type (monotypy) *Mangilia cancellata* A. Adams, 1865. Syn. *Citharopsis* (emend. pro *Cytharopsis*) Crosse, 1866, Journ. de Conchyl., 14, p. 193 (non *Citharopsis* Pease, 1868).

This genus was based upon a very brief description of a Japanese Recent shell, unaccompanied by a figure or even dimensions. In a pamphlet, in Japanese except for a brief English summary, Habe, 1961, commented upon 59 of A. Adams's Japanese species that were similarly unfigured but of which the types had been located in the British Museum (Natural History). Unfortunately *Mangilia cancellata* is not among them, so *Cytharopsis* continues to be an unknown quantity.

It may be noted that Wenz (1943, Handb. der Palaeozool. 6, p. 1436) figured *Mangelia solida* Reeve, 1846 as a representative of *Cytharopsis*, which he made a subgenus of "*Cythara*". If this association should prove to be correct then *Cytharopsis* may have to replace *Eucithara*.



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## DESCRIPTION OF PLATES

### PLATE 1.

#### SPEIGHTIIDAE

- Fig. 1—*Speightia spinosa* (Suter, 1917), Waihao Downs, New Zealand (Eocene); 85 mm.
- Fig. 2—*Clinuropsis ampla* (Briart & Cornet, 1871), Belgium, Mons (Paleocene) (Briart & Cornet, 1871, pl. 4, f. 8).
- Fig. 3—*Clinuropsis diderrichi* Vincent, 1913, Belgian Congo (Paleocene) (Vincent, 1913, pl. 2, f. 8); 70 mm.
- Fig. 4—*Andicula occidentalis* (Woods, 1922), Peru (lower Eocene); 85+ mm.

#### TURRIDAE

- Fig. 5—*Turricula tornata* (Dillwyn, 1817), Southern India; 85 mm.
- Fig. 6—*Turricula javana* (Linnaeus, 1767), India, Bombay; 70 mm.
- Fig. 7—*Comitas onokeana vivens* Dell, 1956, New Zealand, Chatham Rise, 260 fathoms; 30 mm.
- Fig. 8—*Comitas fusiformis* (Hutton, 1877), Rifle Butts, Oamaru (Oligocene); 60 mm.
- Fig. 9—*Paradrillia patruelis* (Smith, 1875), Japan (paratype; Brit. Mus.); 26.5 mm.
- Fig. 10—*Iwaoa reticulata* Kuroda, 1953, Japan, off Tosa, 150 fathoms (Habe, 1961, pl. 38, f. 14); 24.5 mm.
- Fig. 11—*Anticomitas vivens* Powell, 1942, New Zealand, 140 fathoms (Powell, 1942, pl. 10, f. 11); 9.5 mm.
- Fig. 12—*Makiyamaia coreanica* (Adams & Reeve, 1850), Japan, off Sagami Bay; 34 mm.
- Fig. 13—*Marshallaria waitakiensis* Powell, 1942, New Zealand, Otiake (Oligocene) (Powell, 1942, pl. 3, f. 11); 30.8 mm.
- Figs. 14, 15—*Marshallina neozelanica* (Suter, 1917), New Zealand, McCullough's Bridge (Eocene); 14 mm.
- Fig. 16—*Notogenota finlayi* Powell, 1942, New Zealand, McCullough's Bridge (Eocene) (Powell, 1942, pl. 3, f. 10); 32.3 mm.
- Fig. 17—*Notogenota goniodes* (Suter, 1917), New Zealand, Waihao Downs (Eocene) (Suter, 1917, pl. 3, f. 16); 24+ mm.

### PLATE 2.

- Fig. 1—*Paracomitas castlecliffensis* (Marshall & Murdoch, 1919), New Zealand, Castlecliff (Pleistocene) (Powell, 1942, pl. 10, fig. 1); 15 mm.
- Figs. 2, 3—*Antimelatoma buehanani maorum* (Smith, 1877), New Zealand, Great Barrier Island (Recent); 16 mm.
- Fig. 4—*Nihonia shimajiriensis* Mac Neil, 1960, Okinawa (Miocene) (Mac Neil, 1960, pl. 5, fig. 15); 26+ mm.
- Fig. 5—*Nihonia mirabilis* (Sowerby, 1914), Japan (Recent); 73 mm.
- Fig. 6—*Leucosyrinx verrilli* (Dall, 1881), South Carolina, 478 fathoms; 42 mm.

- Fig. 7—*Leucosyrinx janetae* Bartsch, 1934, Puerto Rico Deep, 270-330 fathoms; 48 mm.
- (Cooper, 1894), California (Eocene) (Vokes, Figs. 8, 9—*Leucosyrinx* (n. subgen. \*) *pyramidalis* (Schepman, 1913), Timor Sea, 918 metres (Schepman, 1913, pl. 27, fig. 10); 45 mm.
- Figs. 10, 11—*Vexitomina metcalfei* (Angas, 1867), Port Jackson, Australia (Recent); 19 mm.
- Fig. 12—*Knefastia olivacea* (Sowerby, 1834), West Mexico, Guaymas; 42 mm.
- Fig. 13—*Fusiturricula armilda* (Dall, 1908), Gulf of California, 100-125 fathoms; 40 mm.
- Fig. 14—*Fusiturricula* (*Crenaturricula*) *crenatospira* (Cooper, 1894), California (Eocene) (Vokes, 1939, pl. 17, fig. 4); 37 mm.
- Fig. 15—*Cruziturricula cruziana* (Olsson, 1932), Peru (Miocene) (Olsson, 1932, pl. 8, f. 6); 25 mm.
- Fig. 16—*Rhodopetoma rhodope* (Dall, 1919), California, 82 fathoms off Santa Rosa Island, California (Dall, 1919, pl. 12, fig. 3); 19 mm.
- Fig. 17—*Fusiturricula* (*Fusisyrinx*) *fenimorei* (Bartsch, 1934), Puerto Rico Deep (M.C.Z. coll., V. Maes. photo); 71 mm.
- Fig. 18—*Megasurcula carpenteriana tryoniana* (Gabb, 1866), California (Recent); 100 mm.
- Fig. 19, 20—*Hormospira maculosa* (Sowerby, 1834), West Mexico (Recent); 50 mm.
- Fig. 21—*Pseudomelatoma* (*Laevitectum*) *eburnea* (Carpenter, 1865), Gulf of California (Recent) (Dall, 1919, pl. 13, fig. 5); 30 mm.
- Fig. 22—*Tiariturris spectabilis* Berry, 1958, Costa Rica (Recent); 80 mm.

### PLATE 3.

- Fig. 1—*Pseudomelatoma penicillata* (Carpenter, 1865), Southern California (Recent); 28 mm.
- Fig. 2—*Austrocarina recta* (Hedley, 1903), 75 fathoms off New South Wales (Hedley, 1922, p. 223, fig. 3); 6 m.
- Fig. 3—*Bathybela nudator* (Locard, 1897), Azores, 4010-4060 metres (Locard, 1897, pl. 10, fig. 5); 40 mm.
- Fig. 4—*Belomitra fischeri* Locard, 1897, off Spain, 608 metres (Locard, 1897, pl. 13, fig. 7); 22 mm.
- Fig. 5—*Belaturricula turrita* (Strebel, 1908), off South Georgia, 160 metres; 50 mm.
- Figs. 6, 7—*Clavosurcula sibogae* Schepman, 1913, Flores Sea, 794 metres (Schepman, 1913, pl. 28, fig. 7); 38 mm.
- Fig. 8—*Typhlosyrinx vepallida* (Martens, 1902), Gulf of Aden, 1840 metres (Martens, 1903, pl. 2, fig. 6); 44 mm.
- Figs. 9, 10—*Amuletum macnairyensis* (Wade, 1926), Tennessee, Coon Creek (Cretaceous) Sohl, 1964, pl. 45, figs. 1, 2; 11.6 mm.
- Fig. 11—*Amuletum* (*Lutema*) *simpsonensis* (Stephenson, 1941, Texas (Cretaceous) Stephenson, 1941, pl. 71, fig. 22); 13.5 mm.



- Figs. 12, 13—*Remnita biacuminata* (Wade, 1926), (Tennessee (Cretaceous) (Sohl, 1964, pl. 46, figs. 7, 8); 42.8 mm.  
 Fig. 14—*Fusimilis proxima* (Wade, 1926), Tennessee (Cretaceous) (Sohl, 1964, pl. 46, fig. 27); 88 mm.  
 Figs. 15, 16—*Beretra gracilis* (Wade, 1926), Tennessee Coon Creek (Cretaceous) (Sohl, 1964, pl. 46, figs. 15, 17); 58.7 mm.  
 Fig. 17 — *Catenotoma catenata* (Lamarck, 1804), France, Paris Basin (Eocene); 36 mm.  
 Fig. 18—*Zemacies simulacrum* Laws, 1935, New Zealand, Clifden (Miocene); 49 mm.  
 Fig. 19—*Insolentia pareoraensis* (Suter, 1907), New Zealand, White Rock River (Oligocene); 20 mm.  
 Fig. 20 — *Austrotoma minor* (Finlay, 1924), New Zealand, White Rock River (Oligocene); 44 mm.  
 Fig. 21—*Stenodrillia allionii* (Bellardi, 1877), Italy, Albenga (Pliocene) (Brit. Mus., photo.); 29.6 mm.  
 Fig. 22 — *Tholitoma dolorosa* Finlay & Marwick, 1937, New Zealand, Wangaloa (Paleocene) (Finlay & Marwick, 1937, pl. 12, fig. 11); 14 mm.  
 Fig. 23 — *Apiotoma pirulata* (Deshayes, 1834), France, Paris Basin (Eocene); 19 mm.  
 Fig. 24 — *Scalaturris riedeli* Brebion, 1954, West Africa, Cameroons (Cretaceous) (Brebion, 1954, pl. 7, fig. 10).

## PLATE 4.

- Fig. 1 — *Acamptogenotia intorta* (Brocchi, 1814), Italy (Pliocene) (Brit. Mus., photo.); 43 mm.  
 Figs. 2, 3—*Belophos woodsi* (Tate, 1888), Tasmania, Table Cape (Oligocene); 42 mm.  
 Fig. 4—*Belatomina pulchra* (Tate, 1888), Victoria, Balcombe Bay (Miocene); 28 mm.  
 Fig. 5—*Liratomina crassilirata* (Tate, 1888), Victoria, Balcombe Bay (Miocene); 29 mm.  
 Fig. 6—*Liratomina sculptilis* (Tate, 1888), Victoria, Muddy Creek Ir. (Miocene); 31 mm.  
 Fig. 7 — *Struthiolariopsis ferrieri* (Philippi, 1887), Chile (Cretaceous) (Marwick, 1924, p. 161, fig. 1a).  
 Fig. 8—*Pleurofusua longirostropis* (Gregorio, 1890), Alabama (Eocene) (Harris, 1937, pl. 10, fig. 6).  
 Figs. 9, 10 — *Pleurofusua iravadica* (Vredenburg, 1921), Burma (Kama Stage, Miocene) (Vredenburg, 1921, pl. 12, fig. 9); 32 mm.  
 Fig. 11—*Orthosurcula longiforma* (Aldrich, 1897), Mississippi, Red Bluff (Oligocene); 50 mm.  
 Fig. 12—*Sullivania hicoricola* (Harris, 1937), Mississippi, S. of Hickory (Eocene) (Harris, 1937, pl. 11, fig. 23); 13 mm.  
 Fig. 13—*Hemisurcula silicata* (Aldrich, 1899), Alabama (lower Sabine, Eocene) (Harris, 1937, pl. 11, fig. 22); 26 mm.  
 Figs. 14, 15 — *Sullivania perexilis* (Aldrich, 1886), Mississippi, Jackson (Eocene) (Harris & Palmer, 1947, pl. 60, figs. 1, 2); 12-13 mm.  
 Fig. 16—*Eosurcula moorei* (Gabb, 1860), Texas, Caldwell County (Eocene) (Harris, 1937, pl. 8, fig. 10); 33 mm.  
 Figs. 17, 18—*Leptosurcula beadata* (Harris, 1895), Texas, Smithville (Eocene) (Harris, 1937, pl. 13, figs. 30, 31); 30 mm.  
 Fig. 19—*Cochlespirella insignifica* (Heilprin, 1879), Louisiana, Columbus (Eocene) (Harris, 1937, pl. 8, fig. 33); 4 mm.  
 Fig. 20—*Surculoma tabulata* (Conrad, 1833), Alabama, Claiborne (Eocene) (Harris, 1937, pl. 10, fig. 18); 13 mm.  
 Fig. 21—*Surculoma calantica* Harris, 1937 (type of section *Volutapex*), Alabama, Claiborne (Eocene) (Harris, 1937, pl. 10, fig. 19); 10 mm.  
 Fig. 22—*Lyrosurcula gibbera* Harris, 1937, Texas, Smithville (Eocene) (Harris, 1937, pl. 13, fig. 36); 18 mm.  
 Fig. 23 — *Microsurcula pannekoekae* Harris, 1937, Alabama, Claiborne (Eocene) (Harris, 1937, pl. 13, fig. 21); 9 mm.

## PLATE 5.

- Fig. 1—*Microsurcula nucleola* Casey, 1904, Louisiana, St. Maurice (Eocene) (Harris, 1937, pl. 13, fig. 20); 4.8 mm.  
 Fig. 2—*Ancistrosyrinx radiata* Dall, 1889, West Indies, Yucatan Strait, 640 fathoms (Dall, 1889, pl. 12, f. 12); 13 mm.  
 Fig. 3—*Cochlespira cristata* (Conrad, 1847), Mississippi, Vicksburg (Oligocene) (Harris, 1937, pl. 9, fig. 1); 10 mm.  
 Fig. 4—*Cochlespira bella* Conrad, 1865, Alabama, Woods Bluff (Eocene) (Harris, 1937, pl. 9, fig. 4); 22 mm.  
 Fig. 5—*Cochlespira venusta* (Powell, 1944) (type of *Coronasyrinx*), Balcombe Bay, Victoria (Miocene) (Powell, 1944, pl. 1, fig. 1); 14.8 mm.  
 Fig. 6—*Cochlespira subterebralis* (Bellardi, 1847) (type of *Rouaultia*), Vienna Basin (Miocene) (Hoernes, 1856, pl. 39, fig. 16a).  
 Fig. 7—*Cochlespiropsis engonata* (Conrad, 1865), Texas, Stone City (Eocene); 30 mm.  
 Fig. 8—*Tahusyrinx finlayi* (Allan, 1926), New Zealand, McCullough's Bridge (Eocene) (holotype); 17 mm.  
 Fig. 9—*Lirasyrinx anomala* Powell, 1942, New Zealand, Wharekuri (Oligocene) (Powell, 1942, pl. 13, fig. 6); 7+ mm.  
 Fig. 10—*Parasyrinx alta* (Harris, 1897), New Zealand, Awamoa (Oligocene); 22 mm.  
 Fig. 11 — *Cosmasyrinx monilifera* Marwick, 1931, New Zealand, Gisborne (Miocene) (Marwick, 1931, pl. 16, fig. 292); 12 mm.  
 Fig. 12—*Aforia circinata* (Dall, 1873), off Unalaska (photo., USNM); 75 mm.  
 Fig. 13—*Aforia goodei* (Dall, 1889) (type of *Irenosyrinx*), N.W. of Patagonia, 1050 fathoms (photo., USNM); 80 mm.  
 Fig. 14 — *Steiraxis aulaca* Dall, 1895, off West Mexico, 1879 fathoms (photo., USNM); 60 mm.  
 Fig. 15 — *Eopleurotoma multicostata* (Deshayes, 1834), France, Paris Basin (Eocene) (Brit. Mus. photo.); 21.2 mm.  
 Fig. 16—*Eopleurotoma (Oxyacrum) obliterated* (Deshayes, 1834), France, Paris Basin (Eocene); 10 mm.  
 Fig. 17 — *Eoturris multicinctus* (Marshall, 1917), New Zealand, Matau fauna (Bortonian, Eocene) (Finlay & Marwick, 1937, pl. 16, fig. 2); 11+ mm.  
 Fig. 18—*Campylacrum sanum* Finlay & Marwick, 1937, New Zealand, Wangaloa (Paleocene) (Finlay & Marwick, 1937, pl. 12, fig. 4); 8 mm.  
 Fig. 19—*Epaxlis crenulata* (Lamarck, 1804), France, Grignon, Paris Basin (Eocene) (Brit. Mus. photo.); 15.3 mm.  
 Fig. 20—*Coronia childreni* (Lea, 1833) (= *acutirostra* Conrad, 1835), Alabama, Gosport sand (Eocene) (Harris, 1937, pl. 1, fig. 22); 14 mm.  
 Fig. 21 — *Coronia (Infracoronia) ludoviciana normani* Harris, 1937, Louisiana, Danville (Eocene) (Harris & Palmer, 1947, pl. 58, fig. 6); 28 mm.  
 Fig. 22—*Hesperiturreis nodocarinata* (Gabb, 1860), Texas, Moseley's Ferry (Eocene) (Harris, 1937, pl. 5, fig. 21); 13 mm.  
 Fig. 23—*Trypanotopsis texana* (Gabb, 1860), Texas, Little Brazos River (Eocene) (Harris, 1937, pl. 14, fig. 9); 12 mm.  
 Figs. 24, 25 — *Trypanotoma terebriformis* (Meyer, 1886), Alabama (Eocene) (Cossmann, 1896, pl. 6, figs. 27, 28); 8 mm.  
 Fig. 26 — *Sinistrella americana* (Aldrich, 1885), Louisiana, Danville (Eocene) (Harris & Palmer, 1947, pl. 58, fig. 4); 11 mm.

## PLATE 6.

- Fig. 1 — *Hemipleurotoma archimedis* (Bellardi, 1877), Italy (Miocene) (Grant & Gale, 1931, pl. 26, fig. 36); 38 mm.  
 Fig. 2—*Gemmula speciosa* (Reeve, 1843), China Seas (holotype of *Pl. carinata* Griffith & Pidgeon, 1834); 73 mm.

- Fig. 3—*Gemmula (Unedogemmula) unedo* (Kier, 1839-40), Japan, Tosa, 50 fathoms; 94 mm.
- Fig. 4—*Pinguigemmula okinavensis* Mac Neil, 1960, Okinawa (Miocene — Pliocene) (Mac Neil, 1960, pl. 9, fig. 12; 41.5 mm).
- Fig. 5—*Pinguigemmula philippinensis* Powell, 1964, Philippines, 280 fathoms off Luzon (holotype); 50.2 mm.
- Fig. 6—*Ptychosyrinx bisinuata* (Martens, 1901), off East Africa, 1079 metres (Martens, 1903, pl. 1, fig. 8); 33 mm.
- Figs. 7, 8—*Ptychosyrinx (Kuroshioturris) hyugaensis* (Shuto, 1961), Japan (lowest Pliocene) (Shuto, 1961, pl. 3, f. 2, 3); 12.9 mm.
- Fig. 9—*Cryptogemma benthina* (Dall, 1908), Gulf of California, 1270 fathoms (Dall, 1908, pl. 1, fig. 7); 28+ mm.
- Fig. 10—*Carinoturris adrastia* Dall, 1919, California, 581 fathoms off Monterey (Dall, 1919, pl. 19, fig. 2); 16 mm.
- Fig. 11—*Epidirella xanthophaes* (Watson, 1886), New South Wales, 30-35 fathoms off Port Jackson (holotype); 24 mm.
- Fig. 12—*Epidirella xanthophaes* (Watson, 1886), New South Wales, 5-8 fathoms, Twofold Bay; 28 mm.
- Fig. 13—*Fusiturris undatiruga* (Bivona, 1832), Spanish Morocco; 60 mm.
- Fig. 14—*Lucerapex casearia* (Hedley & Petterd, 1906), New South Wales, 300 fathoms (Hedley & Petterd, 1906, pl. 35, fig. 5); 13 mm.
- Fig. 15—*Lophiotoma acuta* (Perry, 1811), Fiji, Bega Island; 50 mm.
- Fig. 16—*Lophiotoma (Lophioturris) indica* (Röding, 1798), East Indies; 85 mm.
- Fig. 17—*Turris babylonica* (Linnaeus, 1758), West New Guinea, Soweik; 80 mm.
- Fig. 18—*Turris (Annulaturris) amicta* (Smith, 1877), India, Bombay; 45 mm.
- Fig. 19—New gen. et sp., off Philippines, 162 fathoms (to be described shortly in "Indo-Pacific Mollusca"); 18 mm.
- Fig. 20—*Pleuroliria supramirifica* (Gregorio, 1890), Alabama (Claiborne Eocene) (Harris, 1937, pl. 1, fig. 5); 14 mm.
- Fig. 21—*Pleuroliria subsimilis* Casey, 1904, Mississippi, Red Bluff (Oligocene) (Harris, 1937, pl. 1, fig. 3); 23 mm.
- Fig. 22—*Pleuroliria (Josephina) tenagos* Gardner, 1945, Florida, Shoal River (Miocene) (Gardner, 1937, pl. 38, fig. 25); 39 mm.
- Fig. 23—*Polystira albida* (Perry, 1811), Florida, Key West; 105 mm.
- PLATE 7.
- Fig. 1—*Echinoturris finlayi* (Powell, 1935), New Zealand, Motutara (Oligocene — Miocene); 10 mm.
- Figs. 2, 3—*Antiplanes voyi* (Gabb, 1866), California, 300-400 fathoms off Santa Cruz; 40 mm.
- Fig. 4—*Antiplanes (Rectiplanes) santarosana* (Dall, 1902), California, 53 fathoms off Santa Rosa Island; 39 mm.
- Fig. 5—*Veruturris quadricarinata* (Powell, 1944), Victoria, Muddy Creek (Miocene) (Powell, 1944, pl. 1, fig. 5); 14.5 mm.
- Figs. 6, 7—*Veruturris (Cinguliturris) tatei* (Cossmann, 1896), Victoria, Muddy Creek (Miocene); 22 mm.
- Figs. 8, 9—*Epidirona hedleyi* Iredale, 1931, New South Wales, Port Jackson; 31 mm.
- Fig. 10—*Viridoturris corona* (Laseron, 1954), New South Wales, 50-70 fathoms (holotype); 15 mm.
- Fig. 11—*Xenuroturris cingulifera* (Lamarck, 1822), Andaman Islands; 36-72 mm.
- Fig. 12—*Turridrupa acutigemmata* (Smith, 1877), East Indies (holotype); 22 mm.
- Fig. 13—*Austroturris steira* (Hedley, 1922), New South Wales, 50 fathoms, Cape Three Points (Hedley, 1922, pl. 42, fig. 11); 8 mm.
- Figs. 14-15—*Optoturris optata* (Harris, 1897), Victoria, Balcombe Bay (Miocene) (Harris, 1897, pl. 3, fig. 4); 16.5 mm.
- Fig. 16—*Optoturris edita* Powell, 1944, Victoria, Grice's Creek (Miocene) (Powell, 1944, pl. 7, fig. 3); 25 mm.
- Fig. 17—*Micropleurotoma spirotropoides* (Thiele, 1925), South Africa, 126 metres (Thiele, 1925, pl. 23, fig. 18); 4.5 mm.
- Fig. 18—*Taranis mörchi* (Malm, 1863), Sweden (Recent); 4.5 mm.
- Fig. 19—*Pyrenoturris soriensis* Eames, 1952, Pakistan (Eocene) (Eames, 1952, pl. 6, fig. 141); 17.3+ mm.
- Fig. 20—*Pyrenoturris punjabensis* Eames, 1952, Pakistan (Eocene) (Eames, 1952, pl. 5, fig. 121); 12.4+ mm.
- Figs. 21, 22—*Trachelochetus desmuis* (Edwards, 1856), England, Barton (Eocene) (Cossmann, 1896, pl. 4, figs. 17, 18); 23 mm.
- PLATE 8.
- Fig. 1—*Clavatulula muricata* (Lamarck, 1822), West Africa; 42 mm.
- Fig. 2—*Perrona spirata* (Lamarck, 1816), West Africa, Bengo Bay; 33 mm.
- Fig. 3—*Perrona (Tomellana) lineata* (Lamarck, 1816), West Africa; 24 mm.
- Fig. 4—*Clionella sinuata* (Born, 1778), South Africa, Simon's Bay; 50 mm.
- Figs. 5, 6—*Clionella (Toxiclionella) tumida* (Sowerby, 1870), South Africa, False Bay; 62 mm.
- Figs. 7, 8—*Pusionella nifat* (Bruguère, 1792), West Africa, Senegal; 40 mm.
- Figs. 9, 10—*Borsonia prima* Bellardi, 1839, Italy, Turin (Miocene); 22 mm.
- Fig. 11—*Borsonia (Boettgeriella) gallica* (Peyrot, 1932), France, Aquitaine (Miocene) (Peyrot, 1932, pl. 9); 17.5 mm.
- Fig. 12—*Corieria calvimontana* (Deshayes, 1865), France, Chaumont (Eocene) (Cossmann & Pissarro, 1900, pl. 95); 20 mm.
- Fig. 13—*Pleuropyramis quinqueangularis* (Vredenburg, 1921), Burma (Kama Stage, Miocene) (Vredenburg, 1921, pl. 14, fig. 8); 23 mm.
- Fig. 14—*Borsonella dalli* (Arnold, 1903), California, 400 fathoms (Oldroyd, 1927, pl. 6, fig. 8); 23.5 mm.
- Fig. 15—*Diptychophila occata* (Hinds, 1844), Panama (Reeve, 1845, pl. 23, fig. 197); 11 mm.
- Fig. 16—*Scobinella coelata* Conrad, 1848, Mississippi, Vicksburg (Oligocene) (Harris, 1937, pl. 12, fig. 18); 18 mm.
- Figs. 17, 18—*Domenginella claytonensis* (Gabb, 1864), California, Clayton (Eocene) (Vokes, 1939, pl. 17, figs. 18, 20); 9.3 mm.
- Figs. 19, 20—*Moniliopsis elaborata* (Conrad, 1833), Alabama, Claiborne (Eocene) (Harris, 1937, pl. 12, figs. 1, 4); 24 mm.
- Fig. 21—*Plentaria plenta* (Aldrich & Harris, 1895), Stone City, Texas (Eocene); 48 mm.
- PLATE 9.
- Figs. 1-2—*Protosurcula gabbi* (Conrad, 1865), Texas, Smithville (Eocene) (Harris, 1937, pl. 9, figs. 26, 30); 43 mm.
- Fig. 3—*Vaughanites leptus* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 9, fig. 1); 17.9 mm.
- Fig. 4—*Eoscobinella tahuia* Powell, 1942, New Zealand, McCullough's Bridge (Eocene) (Powell, 1942, pl. 4, fig. 1); 7.4 mm.
- Figs. 5, 6—*Mitratoma bartschi* (Olsson, 1930), Peru (Eocene) (Olsson, 1930, pl. 4, fig. 6); 25 mm.
- Fig. 7—*Eucheilodon reticulata* Gabb, 1860, Texas (Eocene); ca 12 mm.
- Figs. 8, 9—*Buridrillia panarica* (Olsson, 1942), Panama (Pliocene) (Olsson, 1942, pl. 7, f. 4, 5); 72 mm.



- Figs. 10-12—*Darbya lira* Bartsch, 1934, Puerto Rico Deep (Bartsch, 1934, pl. 7, figs. 6, 8 & pl. 6, fig. 4); 22.6 mm.
- Fig. 13 — *Bathytoma cataphracta* (Brocchi, 1814), Italy, Tuscany (Pliocene) Brit. Mus. photo.; 58.3 mm.
- Fig. 14 — *Bathytoma* (*Parabathytoma*) *striatotuberculata* (Yokoyama, 1928), Japan, Takanabe (Pliocene) (Shuto, 1961, pl. 4, fig. 2); 24.8 mm.
- Figs. 15, 16—*Bathytoma* (*Parabathytoma*) *luhdorfi* (Lischke, 1872), Japan (Recent); 73 mm.
- Figs. 17, 18 — *Bathytoma* (*Riuguhdrillia*) *engonia* (Watson, 1881), Japan, 200 fathoms off Tyosi; 36 mm.
- Figs. 19, 20—*Bathytoma* (*Micantapex*) *agnata* (Hedley & Petterd, 1906), New South Wales, 60-100 fathoms off Cronulla; 25 mm.
- Fig. 21 — *Paraborsonia varicosa* (Sowerby, 1850), Dominican Republic (Miocene) (Pilsbry, 1922, pl. 17, fig. 21); 24 mm.
- Fig. 22—*Aphanitoma labellum* (Bellardi & Michelotti, 1841), Italy, Turin (Miocene) (Bellardi, 1877, pl. 7, fig. 28).
- Fig. 23 — *Asthenotoma tuberculata* (Pusch, 1836), Italy (Miocene) (Bellardi, 1877, pl. 7, fig. 26).
- Fig. 24—*Endiatoma quadricincta* (Cossman, 1883), France, Saint-Gobain (Eocene) (Cossman, 1883, pl. 7, fig. 1).
- PLATE 10.
- Fig. 1 — *Glyptotoma crassiplicata* (Gabb, 1860), Texas, Moseley's Ferry (Eocene) (Harris, 1937, pl. 3, fig. 26); 7 mm.
- Fig. 2—*Cryptoborsonia pleurotomella* Powell, 1944, Victoria, Balcombe Bay (Miocene) (Powell, 1944, pl. 1, fig. 12); 10 mm.
- Fig. 3—*Mitromorpha carpenteri* (Glibert, 1954), California, San Pedro.
- Fig. 4 — *Mitrolumna olivoidea* (Cantraine, 1835), Tunis, 50-100 fathoms.
- Fig. 5—*Mitriothara alba* (Petterd, 1879), Victoria, Flinders (Recent) (Hedley, 1922, pl. 43, fig. 22); 7 mm.
- Fig. 6—*Mitriothara* (*Itia*) *clatrata* (Marwick, 1931), New Zealand, Gisborne (Miocene) (Marwick, 1931, pl. 12, fig. 230); 6.5 mm.
- Fig. 7—*Scrinium furtivum* Hedley, 1922, New South Wales, 80 fathoms (Hedley, 1922, pl. 45, fig. 53); 7.5 mm.
- Fig. 8—*Vexithara nodosolirata* (Suter, 1917), New Zealand, Blue Cliffs (Oligocene); 11 mm.
- Fig. 9—*Zetekia gemmulosa* (C. B. Adams, 1852), Panama (Recent) (Dall, 1919, pl. 1, fig. 1); 6 mm.
- Fig. 10—*Helenella multigranosa* (Smith, 1890), St. Helena (Recent) (A.W.B.P.del.); 4 mm.
- Fig. 11—*Arieliia mitriformis* Shasky, 1961, Gulf of California (Shasky, 1961, pl. 4, fig. 7); 12.5 mm.
- Fig. 12—*Apatarris expeditionis* (Oliver, 1915), Kermadec Islands, 10-30 metres (A.W.B.P.del.); 5 mm.
- Fig. 13 — *Lovellona atramentosa* (Reeve, 1849), Cocos-Keeling, West Island (V. Maes., photo.); 7.4 mm.
- Fig. 14—*Maorimorpha secunda* Powell, 1942, New Zealand, Otago, 72 fathoms (Powell, 1942, pl. 5, fig. 1); 4.6 mm.
- Fig. 15—*Awateria streptophora* Suter, 1917, New Zealand, Awatere (Pliocene) (Suter, 1917, pl. 12, fig. 19); 11 mm.
- Fig. 16—*Awateria* (*Mioawateria*) *personata* Powell, 1942, New Zealand, Wairoa (Pliocene) (Powell, 1942, pl. 11, fig. 3); 7 mm.
- Fig. 17—*Clavus flammulatus* Montfort, 1810, Philippines, Davao (Recent); 45 mm.
- Fig. 18—*Clavus canicularis* (Röding, 1798) (type of *Tylotia*), New Guinea, Madang (Recent); 30 mm.
- Figs. 19, 20—*Clavus johnsoni* (Bartsch, 1934) (type of *Eldridgea*), off Puerto Rico, 200-300 fathoms (Bartsch, 1934, pl. 1, figs. 1-3); 31 mm.
- Fig. 21—*Clavus aenigmatica* (Dautzenberg & Fischer, 1897) (type of *Aliceia*), Azores, 743-1010 fathoms.
- Fig. 22 — *Clavus* (*Plagiostropha*) *quintuplex* (Melvill, 1927), locality unknown (Melvill, 1927, pl. 12, fig. 5); 11 mm.
- Fig. 23 — *Tylotiella subobliquata* (Smith, 1879) Japan, 40 fathoms (holotype); 18 mm.
- PLATE 11.
- Fig. 1—*Drillia umbilicata* Gray, 1838, West Africa (Recent); 31 mm.
- Fig. 2—*Clathrodrillia gibbosa* (Born, 1778), West Indies (Recent); 43 mm.
- Fig. 3—*Kylix alcyone* (Dall, 1919), off West Mexico, 76 fathoms (Dall, 1919, pl. 2, fig. 3); 15 mm.
- Fig. 4—*Clathrodrillia* (*Imaclava*) *pembertonii* (Lowe, 1935), Costa Rica (Recent); 51 mm.
- Fig. 5—*Neodrillia cydia* Bartsch, 1943, Florida, 25 fathoms (Bartsch, 1943, pl. 7, fig. 6); 15.9 mm.
- Fig. 6—*Cerodrillia clappi* Bartsch & Rehder, 1939, Florida, 4 fathoms (Bartsch & Rehder, 1939, pl. 17, fig. 4); 11.5 mm.
- Fig. 7—*Cerodrillia* (*Lissodrillia*) *simpsoni recticostata* Fargo, 1953, Florida (Pliocene) (Fargo, 1953, pl. 19, fig. 3a); 7.8 mm.
- Fig. 8—*Viridrillia hendersoni* Bartsch, 1943, Florida, 80 fathoms (Bartsch, 1943, pl. 7, fig. 3); 10.9 mm.
- Fig. 9—*Elaeocyma empyrosia* (Dall, 1899), California, off San Pedro (Dall, 1919, pl. 4, fig. 1).
- Figs. 10, 11—*Spirotropis carinatus* (Philippi, 1844), Lofoten Islands, 100-120 fathoms.
- Fig. 12—*Crassispira bottae* (Kiener, 1839-40), West Mexico, Bahia de Adair; 51 mm.
- Fig. 13—*Crassispira* (*Crassispirella*) *rugitecta* (Dall, 1918), Lower California, off San Bartolome Bay (Dall, 1919, pl. 7, fig. 6); 30 mm.
- Fig. 14—*Crassispira* (*Monilispira*) *monilis* (Bartsch & Rehder, 1939), Florida (Recent) (Bartsch & Rehder, pl. 17, fig. 10); 12.5 mm.
- Fig. 15 — *Crassispira* (*Dallspira*) *lowei* (Bartsch, 1950), Nicaragua (Recent) (Bartsch, 1950, pl. 6, fig. 1); 14.7 mm.
- Fig. 16—*Crassispira* (*Striospira*) *tabogaensis* Bartsch, 1950, Panama, Taboga Island (Bartsch, 1950, pl. 6, fig. 3); 20.2 mm.
- Fig. 17—*Crassispira* (*Pilsbryspira*) *pilsbryi* (Bartsch, 1950), Panama, Taboga Island (Bartsch, 1950, pl. 6, fig. 2); 12.3 mm.
- Fig. 18—*Crassispira* (*Adanaclava*) *adana* (Bartsch, 1950), West Mexico, Manzanillo (Bartsch, 1950, pl. 6, fig. 4); 12.2 mm.
- Figs. 19—*Crassispira* (*Zonulispira*) *reigeni* (Bartsch, 1950), West Mexico (Bartsch, 1950, pl. 6, fig. 5); 21.7 mm.
- Fig. 20—*Crassispira* (*Burchia*) *redondoensis* (Burch, 1938), California, 25 fathoms, Redondo Beach; 45 mm.
- PLATE 12.
- Fig. 1—*Carinodrillia halis* (Dall, 1919), Lower California, 21 fathoms La Paz (Dall, 1919, pl. 5, fig. 4); 20 mm.
- Figs. 2, 3—*Carinodrillia* (*Buchema*) *tainoa* Corea, 1934, Puerto Rico Deep, 80-120 fathoms (Corea, 1934, pl. 1, figs. 5, 6); 14.2 mm.
- Fig. 4—*Inquisitor sterrhus* (Watson, 1881), Queensland, 3-12 fathoms Cape York (holotype), 36 mm.
- Figs. 5, 6—*Inquisitor crenularis* (Lamarck, 1816), (type of *Ptychobela*), Ceylon; 32 mm.
- Fig. 7 — *Inquisitor problematicus* (Powell, 1942) (type of *Pseudoinquisitor*), New Zealand, Pukeuri (Oligocene) (Powell, 1942, pl. 3, fig. 3); 21.8 mm.
- Fig. 8—*Tomopleura* (*Maoritomella*) *albula* (Hutton, 1873), New Zealand, 9 fathoms Omaha Bay; 9 mm.
- Figs. 9, 10 — *Tomopleura pouloensis* (Jousseaume, 1883), Aden (Recent); 26 mm.
- Figs. 11-12—*Phenatoma rosea* (Quoy & Gaimard, 1833), New Zealand, Pilot Bay, Tauranga; 34 mm.



Fig. 13 — *Microdrillia cossmanni* (Meyer, 1887), Mississippi, Jackson (Eocene) (Cossmann, 1906, pl. 14, fig. 18); 8 mm.

Fig. 14 — *Microdrillia pakaurangia* Powell, 1942, New Zealand, Pakaurangi Point (Oligocene) (Powell, 1942, pl. 2, fig. 9); 8.75 mm.

Fig. 15 — *Suavodrillia kennicottii* (Dall, 1871), Alaska, Unga Island (USNM, photo.); 21 mm.

Figs. 16, 17 — *Typhlomangelia nivalis* (Loven, 1846), Norway (Recent); 16 mm.

Fig. 18 — *Haedroleura septangularis* (Montagu 1803), European Seas (Thiele, 1929, p. 362, fig. 444); 14 mm.

Fig. 19 — *Splendrillia woodsi* (Beddome, 1883), Victoria, Lakes Entrance; 14 mm.

Fig. 20 — *Splendrillia* (*Syntomodrillia*) *lissotropis* (Dall, 1881), Gulf of Mexico, 220 fathoms (Dall, 1889, pl. 11, fig. 4); 4.5 mm.

Fig. 21 — *Splendrillia* (*Hauturua*) *vivens* (Powell, 1942), New Zealand, off Little Barrier Island (Powell, 1942, pl. 2, fig. 5); 9.9 mm.

Fig. 22 — *Austrodrillia* (*Regidrillia*) *sola* Powell, 1942, New Zealand, 100 fathoms, Three Kings Islands (Powell, 1942, pl. 10, fig. 4); 10.3 mm.

#### PLATE 13.

Fig. 1 — *Inodrillia miamia* Bartsch, 1943, Florida, 60 fathoms off Miami (Bartsch, 1943, pl. 9, fig. 9); 14.5 mm.

Fig. 2 — *Austrodrillia angasi* (Crosse, 1863), New South Wales, Port Jackson (Hedley, 1922, pl. 44, fig. 38); 17 mm.

Fig. 3 — *Conticosta petilinus* (Hedley, 1922), New South Wales, Jervis Bay (Hedley, 1922, pl. 44, fig. 36); 12.5 mm.

Fig. 4 — *Paracuneus immaculatus* (Tenison-Woods, 1876), Victoria, Western Port; 18 mm.

Fig. 5 — *Austroclavus clifdenensis* Powell, 1942, New Zealand, Clifden 6c, Southland (Miocene) (Powell, 1942, pl. 1, fig. 1); 8.4 mm.

Fig. 6 — *Pulsarella cognata* (Smith, 1877), New South Wales (Hedley, 1922, p. 219, fig. 1); 24 mm.

Fig. 7 — *Aoteadrillia wanganuiensis chordata* (Suter, 1908), New Zealand, off Otago Heads (Suter, 1908, pl. 7, fig. 16); 9 mm.

Fig. 8 — *Mauidrillia imparilirata* Powell, 1942, New Zealand, Pakaurangi Point (Oligocene) (Powell, 1942, pl. 1, fig. 8); 6.8 mm.

Fig. 9 — *Iredalea subtropicalis* Oliver, 1915, Kermadec Islands, 10-30 metres (Oliver, 1915, pl. 11, fig. 34); 6.2 mm.

Figs. 10, 11 — *Iredalea perfectus* (Pilsbry & Lowe, 1932), Mexico, 20 fathoms, Manzanillo (type of *Brephodrillia*) (Pilsbry & Lowe, 1932, pl. 2, figs. 7, 8); 5.8 mm.

Fig. 12 — *Clavatoma pulchra* Powell, 1942, New Zealand, Gisborne (Pliocene) (Powell, 1942, pl. 12, fig. 8); 22.5 mm.

Fig. 13 — *Maoricrassus carinatus* Vella, 1954, New Zealand, Wairarapa (Miocene) (Vella, 1954, pl. 27, fig. 21); 6.3 mm.

Fig. 14 — *Wairarapa rebecca* Vella, 1954, New Zealand, Wairarapa (Miocene) (Vella, 1954, pl. 27, fig. 20); 7.7 mm.

Fig. 15 — *Mitrellatoma angustata* (Hutton, 1886), New Zealand, Petane (Pleistocene) (Powell, 1942, pl. 12, fig. 7); 10 mm.

Figs. 16, 17 — *Cymatosyrinx lunatus* (Lea, 1843), Florida, Clewiston (Pliocene); 37 mm.

Fig. 18 — *Tahudrillia simplex* Powell, 1942, New Zealand, McCullough's Bridge (Eocene) (Powell, 1942, pl. 4, fig. 4); 9.6 mm.

Fig. 19 — *Carinapex minutissima* (Garrett, 1873), Hawaiian Islands, Oahu (A.W.B.P.del.); 2 mm.

Fig. 20 — *Ceritoturris bittium* Dall, 1924, Hawaiian Islands, Oahu (A.W.B.P.del.); 7 mm.

Fig. 21 — *Brachytoma stromboides* (Sowerby, 1832) (= *strombiformis* Sowerby, 1839), ? Panama (Sowerby, 1832, pl. 16, fig. 381).

Fig. 22 — *Strombinoturris crockeri* Hertlein & Strong, 1951, Gulf of California, 40-45 fathoms (Hertlein & Strong, 1951, pl. 1, fig. 9); 43.2 mm.

#### PLATE 14.

Figs. 1, 2 — *Douglassia enae* Bartsch, 1934, Florida, West Coast, 33-40 fathoms (Bartsch, 1934, pl. 2, figs. 1, 3); 16.6 mm.

Fig. 3 — *Vixinquisitor vixumbilicata* (Harris, 1897), Victoria, Balcombe Bay (Miocene); 15.5 mm.

Fig. 4 — *Integradrillia integra* (Tenison-Woods, 1880), Victoria, Balcombe Bay (Miocene); 33 mm.

Figs. 5, 6 — *Fenimorea janetae* Bartsch, 1934, Florida, West Coast, 33-40 fathoms (Bartsch, 1934, pl. 1, figs. 5, 7); 37.8 mm.

Fig. 7 — *Compsodrillia urceola* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 5, fig. 1); 13.3 mm.

Fig. 8 — *Agladrillia callothyra* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 5, fig. 7); 19.5 mm.

Fig. 9 — *Agladrillia* (*Eumetadrillia*) *serra* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 5, fig. 9); 11.5 mm.

Fig. 10 — *Globidrillia ula* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 5, fig. 16); 5 mm.

Fig. 11 — *Sedilia sedilia* (Dall, 1890), Florida (Pliocene) (Dall, 1890, pl. 2, fig. 1); 10 mm.

Fig. 12 — *Crassopleura maravignae* (Bivona, 1838), Sardinia (Recent); 12 mm.

Fig. 13 — *Drilliola emendata* (Monterosato, 1872) Mediterranean (Kobelt, 1905, pl. 81, fig. 14); 9 mm.

Fig. 14 — *Leptadrillia parkeri* (Gabb, 1873), Dominican Republic (Miocene) (Woodring, 1928, pl. 5, fig. 10); 22.3 mm.

Fig. 15 — *Boreodrillia toftlundensis* Sorgenfrei, 1958, Denmark (Miocene) (Sorgenfrei, 1958, pl. 57, fig. 191a); 3.65 mm.

Fig. 16 — *Tripia anteatripla* Gregorio, 1890, Alabama, Claiborne (Eocene) (Harris, 1937, pl. 3, fig. 12); 13 mm.

Figs. 17, 18 — *Terebritoma solitaria* (Whitfield), Syria (Cretaceous) (Wenz, 1943, p. 1415, f 3996).

Fig. 19 — *Ophiidermella ophioderma* (Dall, 1908), California (USNM, photo.); 47 mm.

Fig. 20 — *Hindsiclava militaris* (Hinds, 1843), Gulf of California, 45 fathoms, 45 mm.

Fig. 21 — *Turrigemma torquifer* Berry, 1958, Baja California, 67 fathoms (Keen, 1958, p. 465, fig. 845); 39.2 mm.

Fig. 22 — *Mitreloturris casteri* (Chavan, 1952), Nigeria, Ameki (Eocene) (Brit. Mus., photo.); 24 mm.

#### PLATE 15.

Figs. 1, 2 — *Conorbis dormitor* (Solander, 1766), England, Barton (Eocene); 21 mm.

Fig. 3 — *Cryptoconus filiosus* (Lamarck, 1804), France, Grignon (Eocene); 27 mm.

Fig. 4 — *Genota mitriformis* (Wood, 1828) West Africa (Recent); 40 mm.

Figs. 5, 6 — *Benthofascis biconica* (Hedley, 1903), South Queensland, 100 fathoms; 40 mm.

Fig. 7 — *Mangelia attenuata* (Montagu, 1803), England, Exmouth; 13 mm.

Fig. 8 — *Buchozia citharella* (Lamarck, 1803), France, Loire (Eocene) (Brit. Mus., photo.).

Fig. 9 — *Enatoma hypothetica* (Bellardi, 1847), Italy, Turin (Miocene) (Bellardi, 1847, pl. 4, fig. 28).

Fig. 10 — *Bela nebula* (Montagu, 1803), England; 12 mm.

Fig. 11 — *Amblyacrum rugosum* (Deshayes, 1834), France, Paris Basin (Eocene) (Cossmann, 1889, pl. 10, fig. 50).

Fig. 12 — *Tenaturris guppyi* (Dall, 1896), Jamaica (Miocene) (Woodring, pl. 7, fig. 16); 6.7 mm.

Fig. 13 — *Lyromangelia taeniata* (Deshayes, 1833), Mediterranean (Tryon, 1884, pl. 21, fig. 13); 9 mm.



- Fig. 14—*Benthomangelia trophonoidea* (Schepman, 1913), Flores Sea, 794 metres (Schepman, 1913, pl. 28, fig. 3); 16 mm.
- Fig. 15—*Agathotoma angusta* (Jan) Bellardi, 1848, Italy (Pliocene) (Bellardi, 1877, pl. 8, fig. 40).
- Fig. 16—*Saccharoturris consentanea* (Guppy, 1896), Jamaica (Miocene) (Woodring, 1928, pl. 7, fig. 11); 6.2 mm.
- Fig. 17—*Clathromangelia granum* (Philippi, 1844), Mediterranean (Recent) (Thiele, 1929, p. 369, fig. 455).
- Fig. 18—*Cryoturris engonia* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 7, fig. 4); 4.6 mm.
- Fig. 19—*Granoturris padolina* Fargo, 1953, Florida (Pliocene) (Fargo, 1953, pl. 23, fig. 5); 8.2 mm.
- Fig. 20—*Mangiliella multilineolata* (Deshayes, 1833), France, Roussillon (Cossmann, 1896, pl. 7, fig. 13); 7 mm.
- Fig. 21—*Cytharella costata* (Donovan, 1803), England (Forbes & Hanley, 1851, pl. 114a, fig. 4); 12 mm.
- Fig. 22—*Glyphoturris rugirima* (Dall, 1889), Florida (Recent) (Perry, 1940, pl. 39, fig. 273) 8 mm.
- Fig. 23—*Notocytharella niobe* (Dall, 1919), Panama (Recent) (Dall, 1919, pl. 23, fig. 4); 6.5 mm.
- Fig. 24 — *Acmatutris comparata* Woodring, 1928, Jamaica (Miocene) (Woodring, 1928, pl. 7, fig. 12); 8.4 mm.
- PLATE 16.
- Fig. 1—*Rubellatoma diomedea* Bartsch & Rehder, 1939, Florida, Sanibel Island (Bartsch & Rehder, 1939, pl. 17, fig. 3) 9.7 mm.
- Fig. 2—*Stellatoma stellata* (Stearns, 1872), Florida, Tampa (Recent) Gardner, 1948, pl. 37, fig. 1); 10 mm.
- Fig. 3—*Kurtzia arteaga roperi* (Dall, 1919), California, Monterey (Dall, 1919, pl. 22, fig. 5); 6.5 mm.
- Fig. 4—*Kurtziella cerina* (Kurtz & Stimpson, 1851), South Carolina (Tryon, 1884, pl. 22, fig. 43); 7 mm.
- Fig. 5—*Kurtzina beta* (Dall, 1919), California, 56 fathoms off Pt. Ano Nuevo (Dall, 1919, pl. 22, fig. 4); 5 mm.
- Fig. 6—*Bellaspira virginiana* (Conrad, 1862), Virginia, Yorktown (Miocene) (Gardner, 1948, pl. 37, fig. 1); ca 14 mm.
- Fig. 7—*Guraleus pictus vincentinus* (Crosse & Fischer, 1865), New South Wales, Port Stephens (Hedley, 1922, pl. 53, fig. 149); 7 mm.
- Fig. 8—*Guraleus pictus meredithae* (Tenison-Woods, 1876), New South Wales, Port Jackson (Hedley, 1922, pl. 53, fig. 150); 9.5 mm.
- Fig. 9—*Euguraleus anisus* Cotton, 1947, Western Australia, 12-14 fathoms, King George Sound (Cotton, 1947, p. 15, fig. —); 7.5 mm.
- Fig. 10—*Mitraguraleus mitralis* (Adams & Angas, 1864), Victoria, Flinders; 17.5 mm.
- Fig. 11—*Neoguraleus sinclairi* (Gillies, 1882), New Zealand, Moeraki (Powell, 1942, pl. 6, fig. 1); 9.25 mm.
- Fig. 12—*Neoguraleus (Fusiguraleus) major* Powell, 1942, New Zealand, Ardgowan (Oligocene) (Powell, 1942, pl. 7, fig. 3); 15.6 mm.
- Fig. 13 — *Neoguraleus (Fusiguraleus) leptosomus* (Hutton, 1885), New Zealand, White Rock River (Oligocene) (Powell, 1942, pl. 7, fig. 4); 5.8 mm.
- Fig. 14—*Antiguraleus otagoensis* Powell, 1942, New Zealand, 50 fathoms off Oamaru (Powell, 1942, pl. 8, fig. 4); 6 mm.
- Fig. 15—*Antiguraleus rossianus* Powell, 1942, New Zealand, 95 fathoms off Auckland Islands (Powell, 1942, pl. 8, fig. 3); 4.3 mm.
- Fig. 16—*Marita compta* (Adams & Angas, 1863), New South Wales, Port Jackson (Hedley, 1922, pl. 53, fig. 139); 14 mm.
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- Fig. 18—*Etremella totomiensis* (Makiyama, 1927), Japan (Pliocene) (Makiyama, 1927, pl. 5, fig. 6); 7.45 mm.
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- Fig. 21—*Liracraea otakaica* Powell, 1942, New Zealand, 60 fathoms off Otago Heads (Powell, 1942, pl. 5, fig. 5); 7.8 mm.
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- Fig. 9—*Etrema aliciae* (Melvill & Standen, 1895), Loyalty Islands (Hedley, 1922, pl. 47, fig. 70); 9 mm.
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- Fig. 11—*Crockerella crystallina* (Gabb, 1865), California, 40 fathoms Catalina Island (Dall, 1921, pl. 6, fig. 4); 7.7 mm.
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Fig. 23—*Lienardia (Hemilienardia) malleti* (Recluz, 1852), Western Samoa; 5.3 mm.

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- Fig. 10—*Nepotilla bathentoma* (Verco, 1909), South Australia, 104 fathoms (Verco, 1909, pl. 28, fig. 3); 2.8 mm.
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## REJECTED OR DOUBTFUL TURRID GENERA

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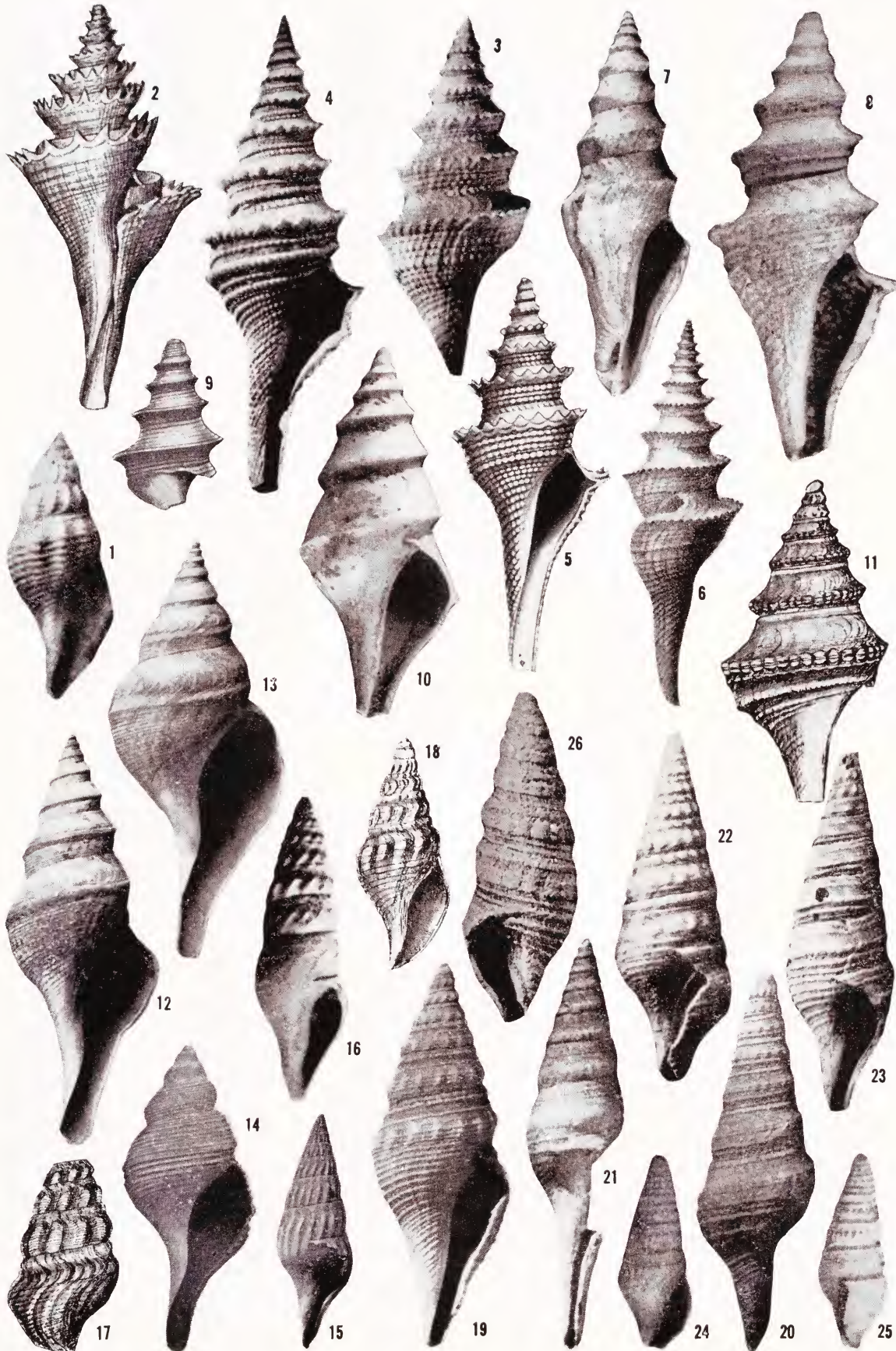






























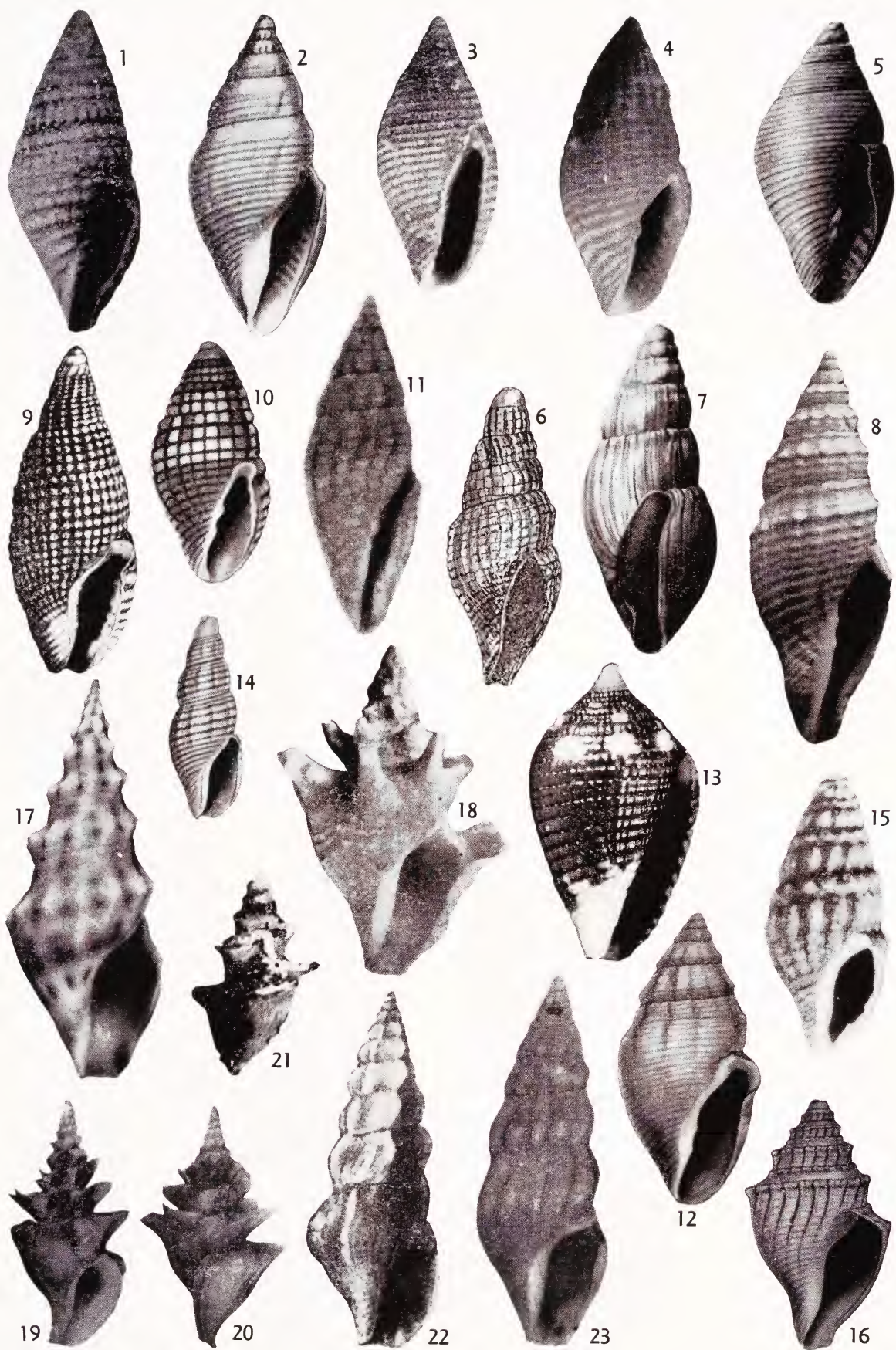






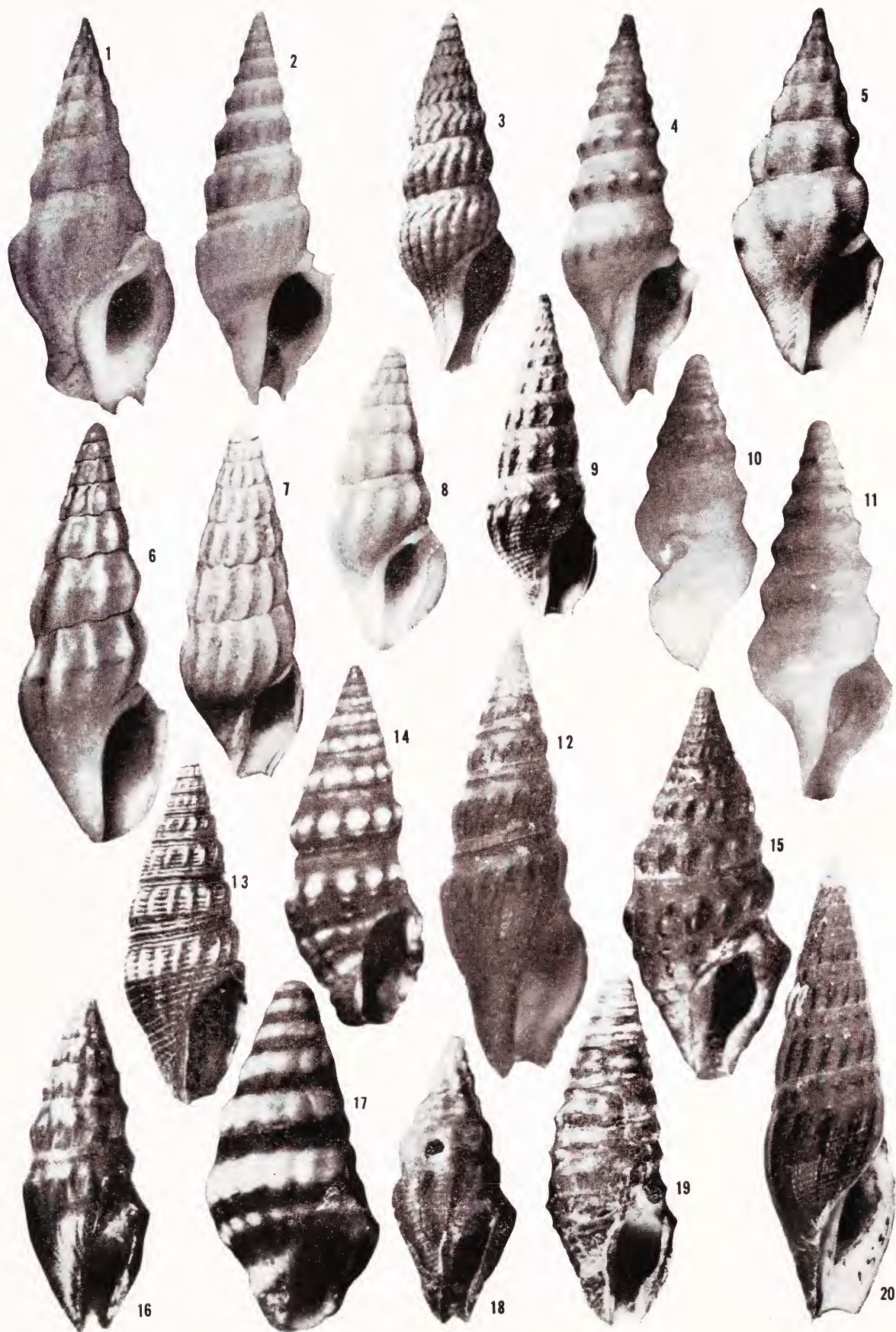












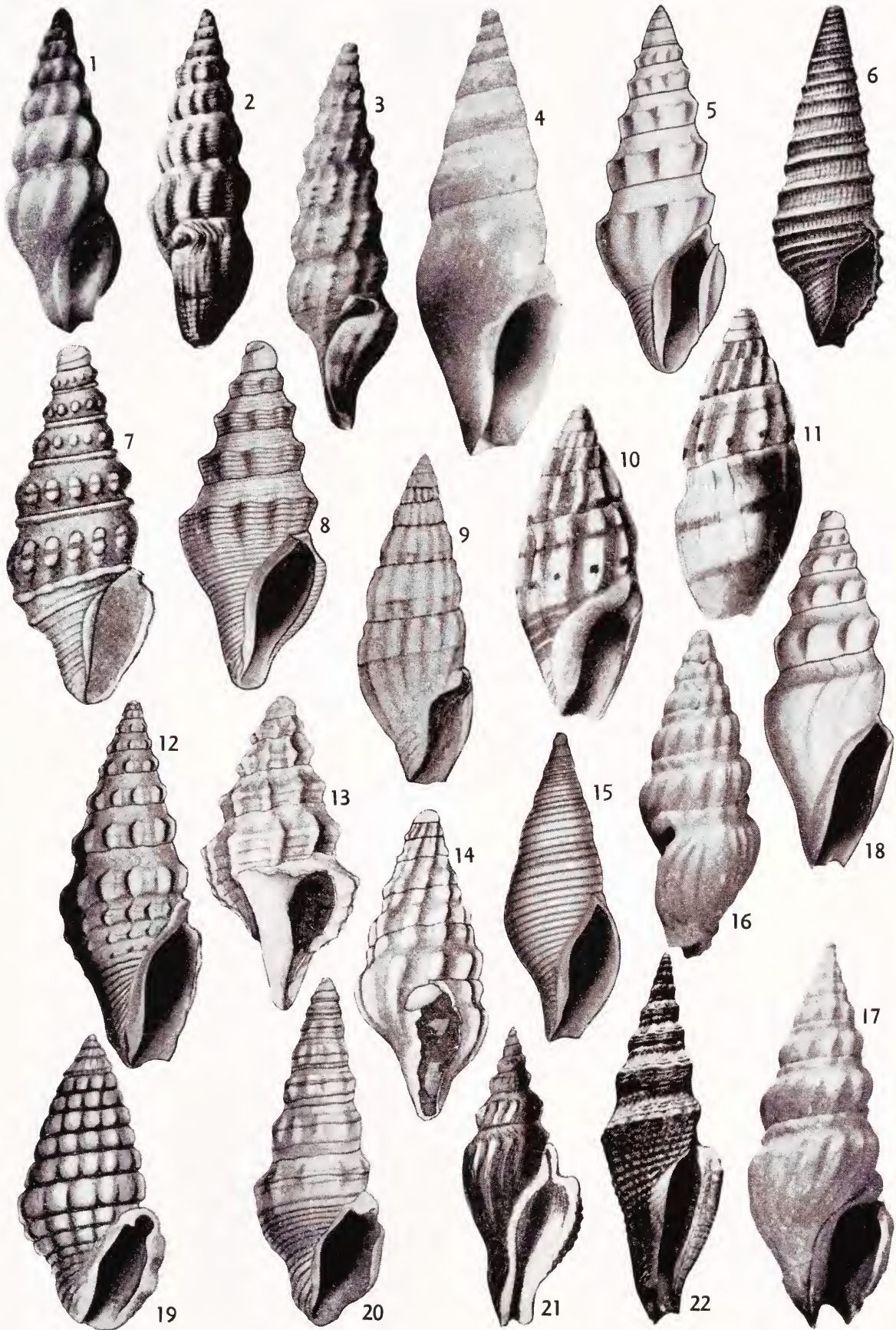






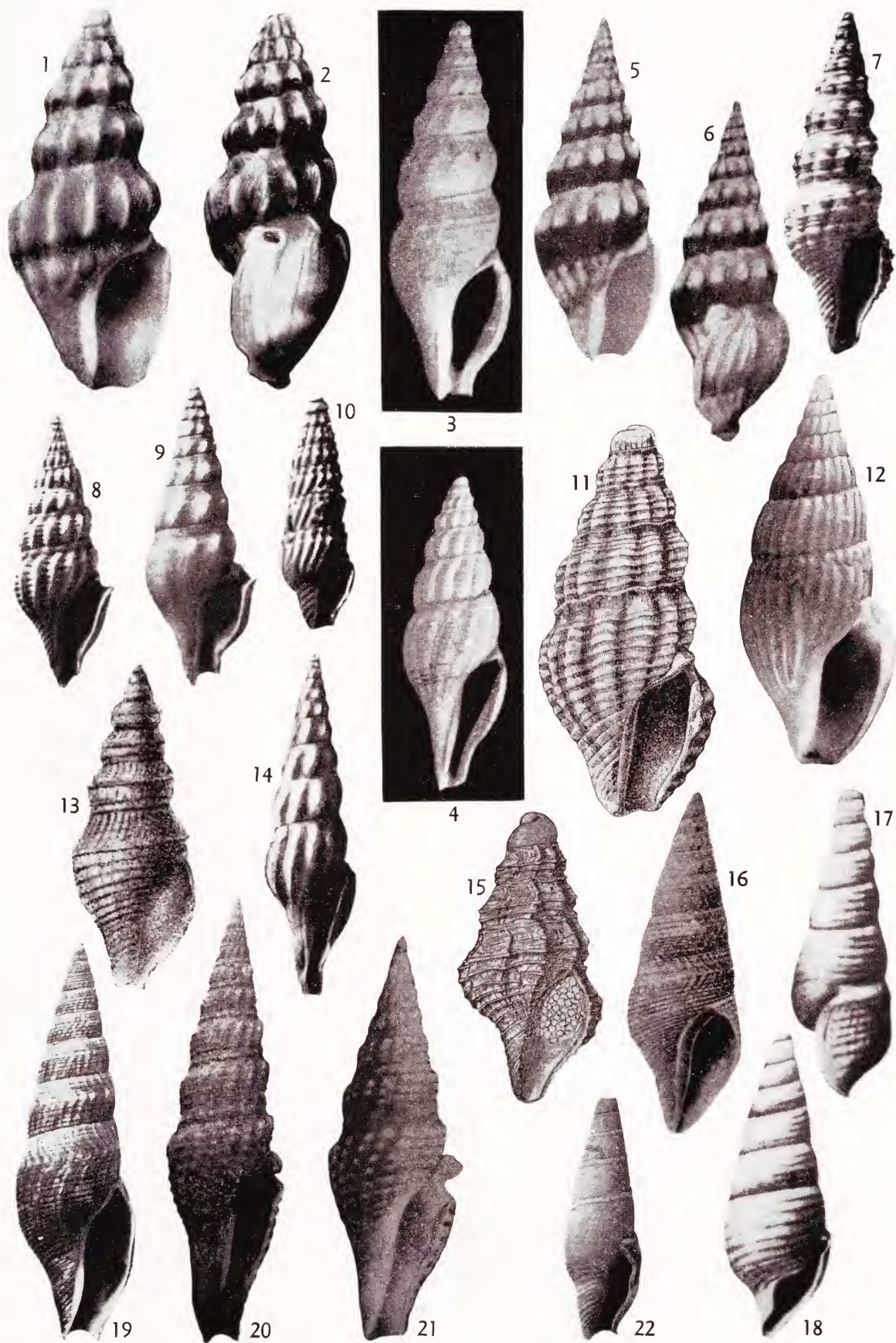






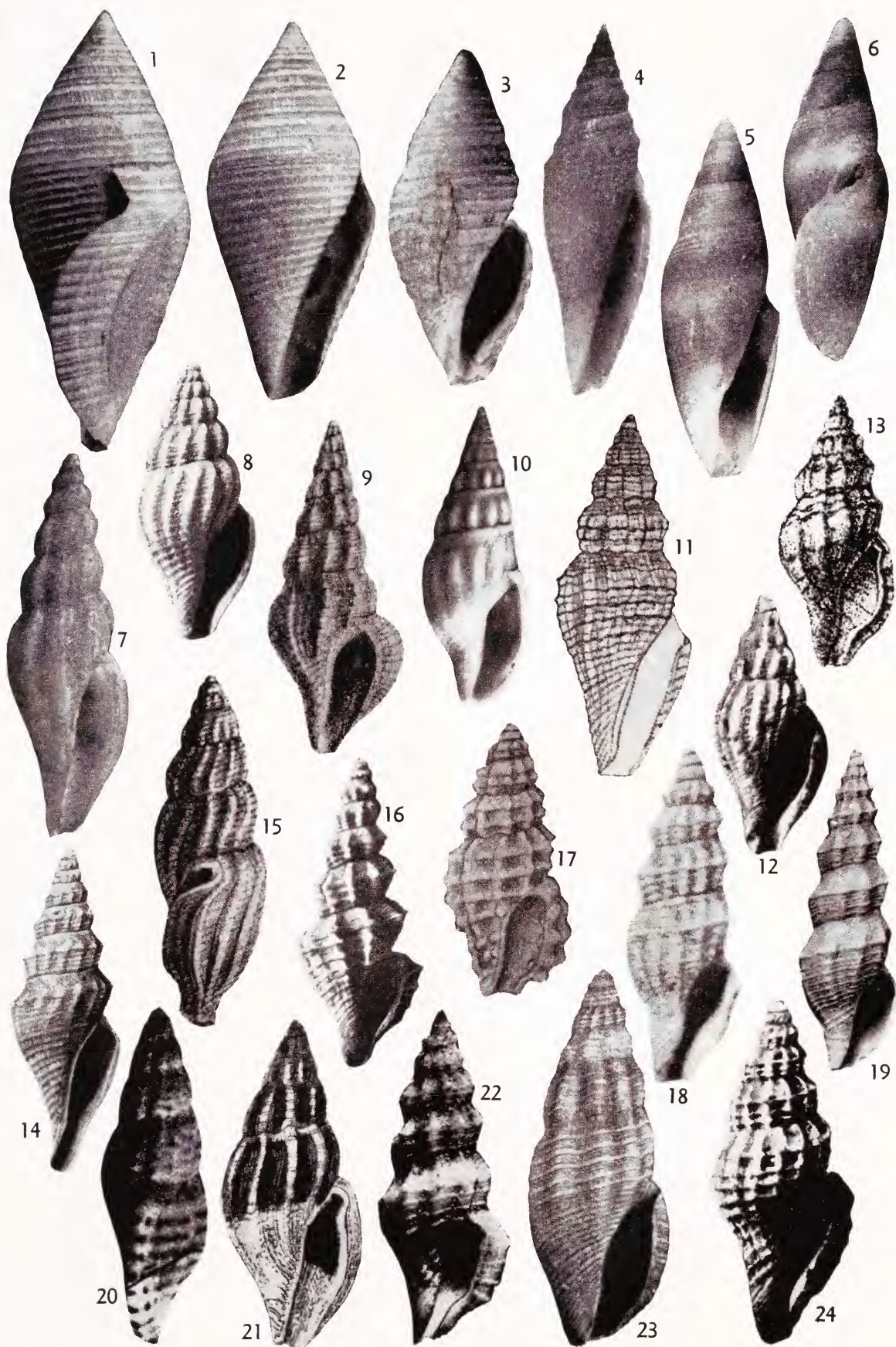












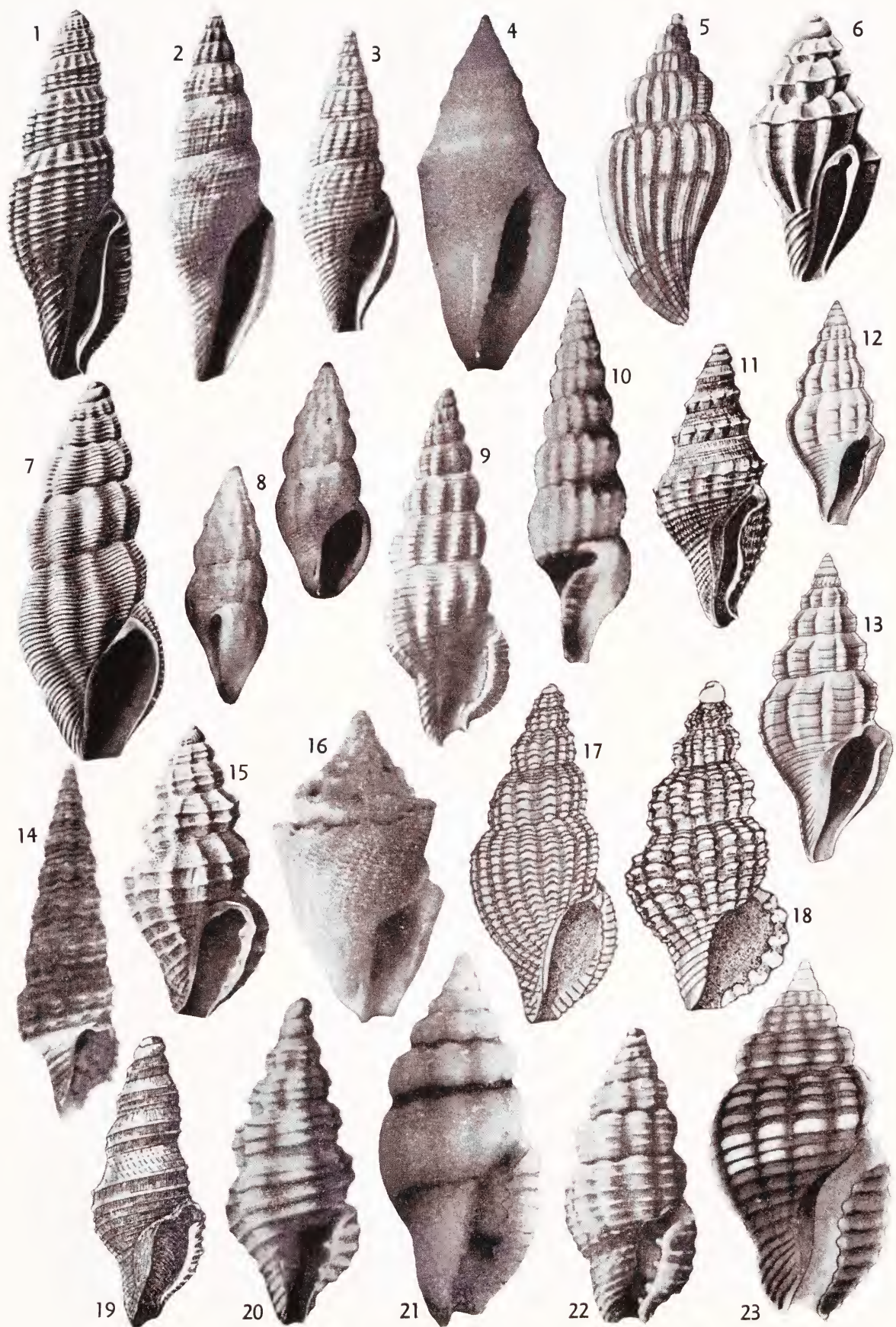






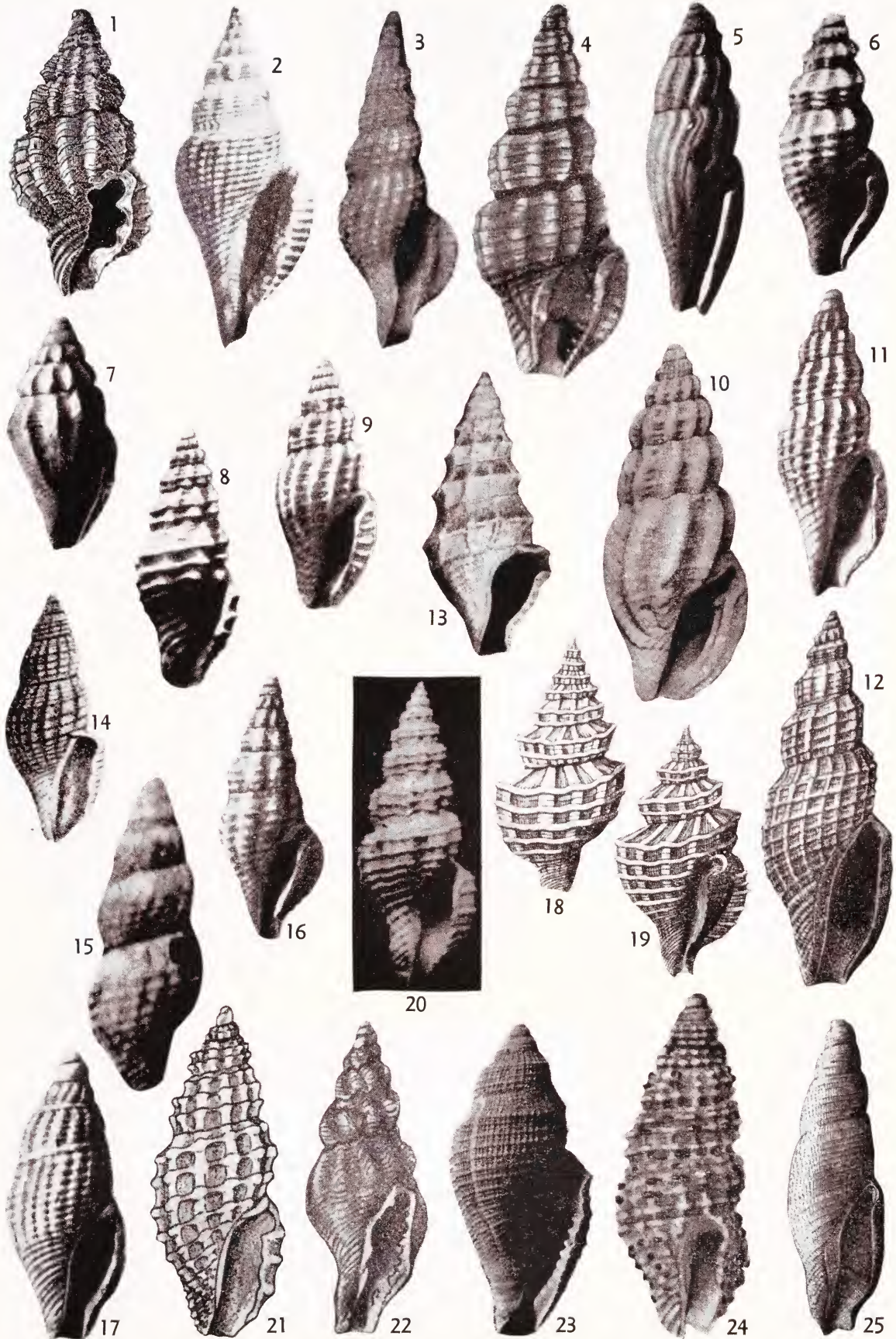






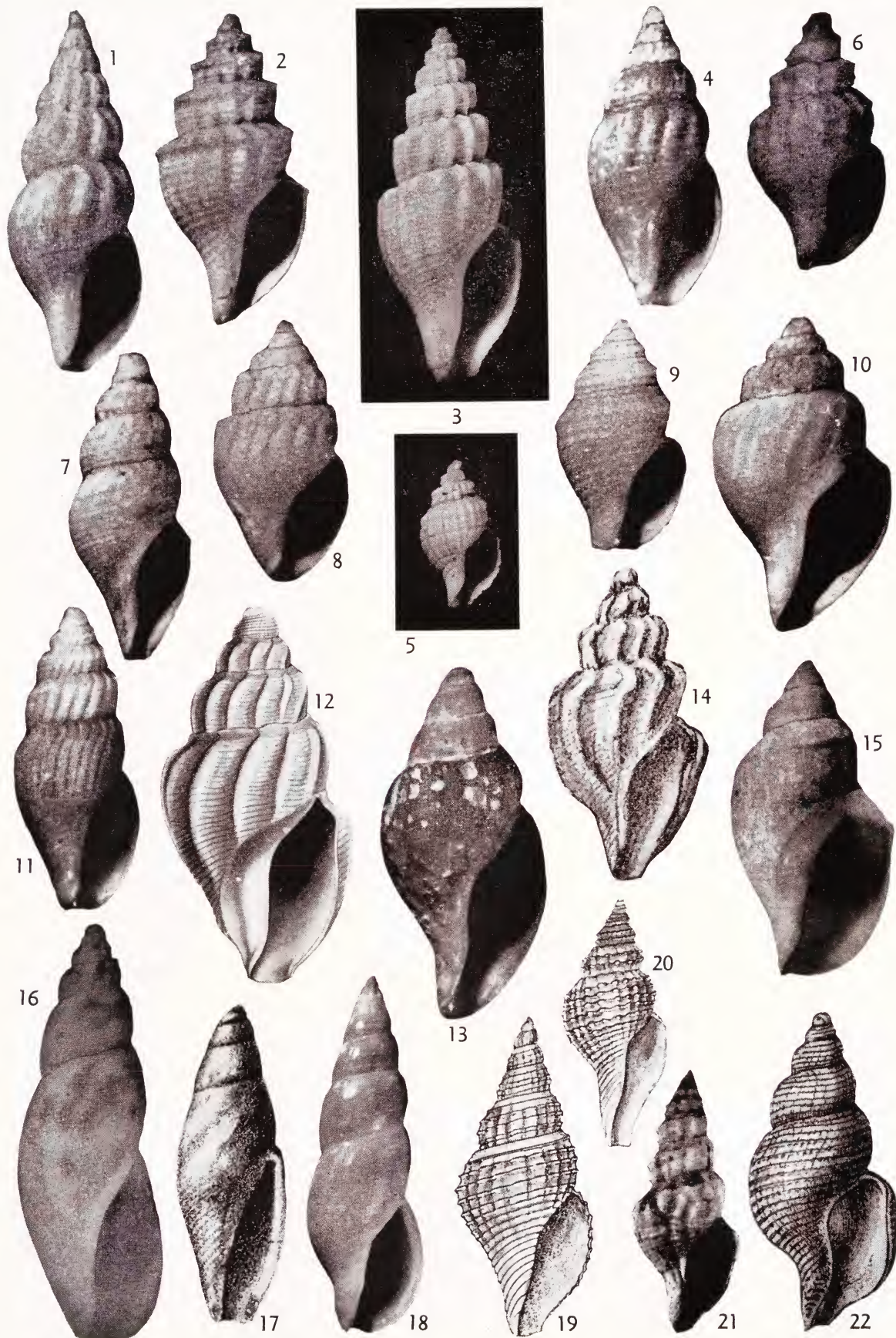


















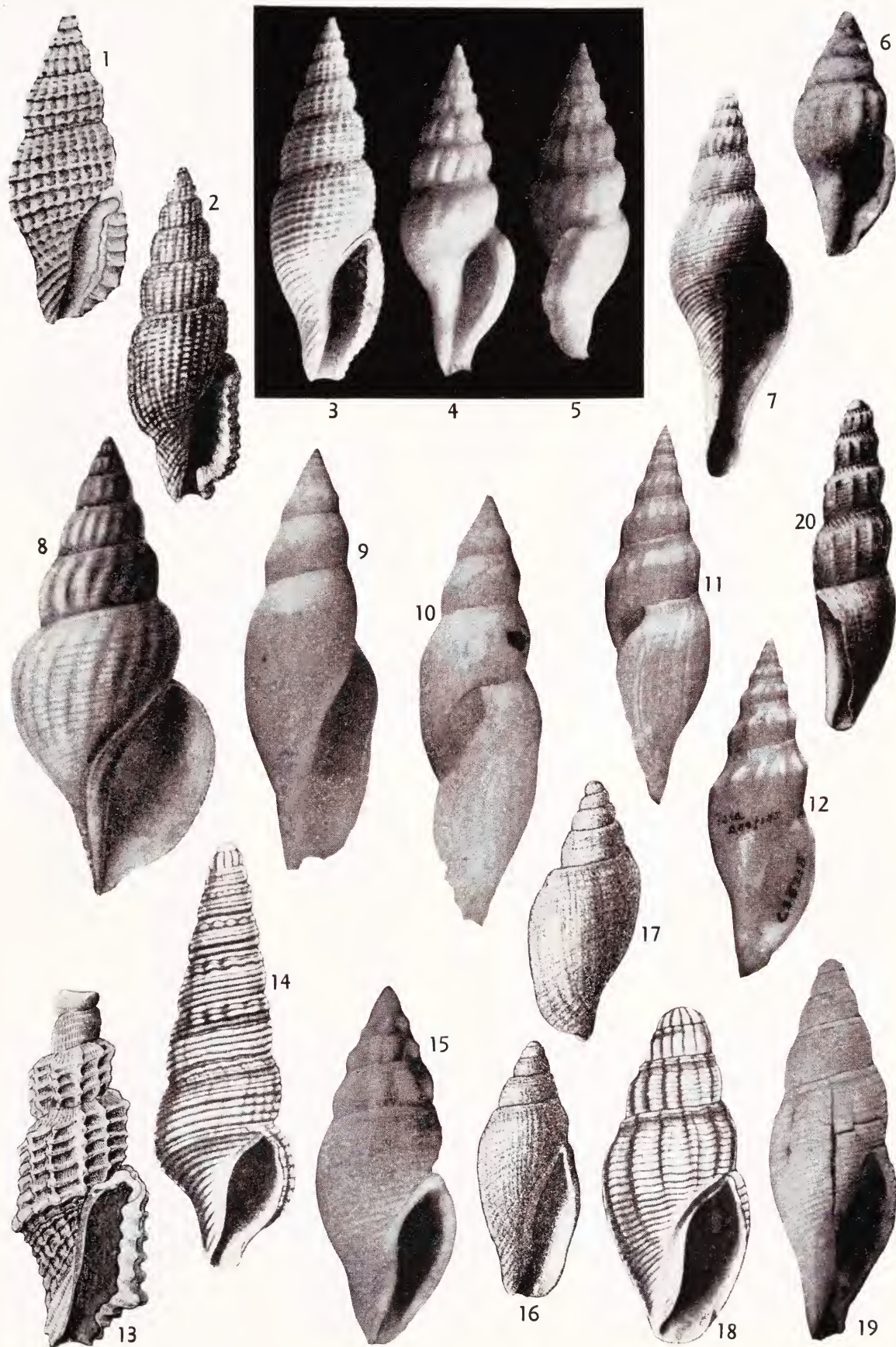






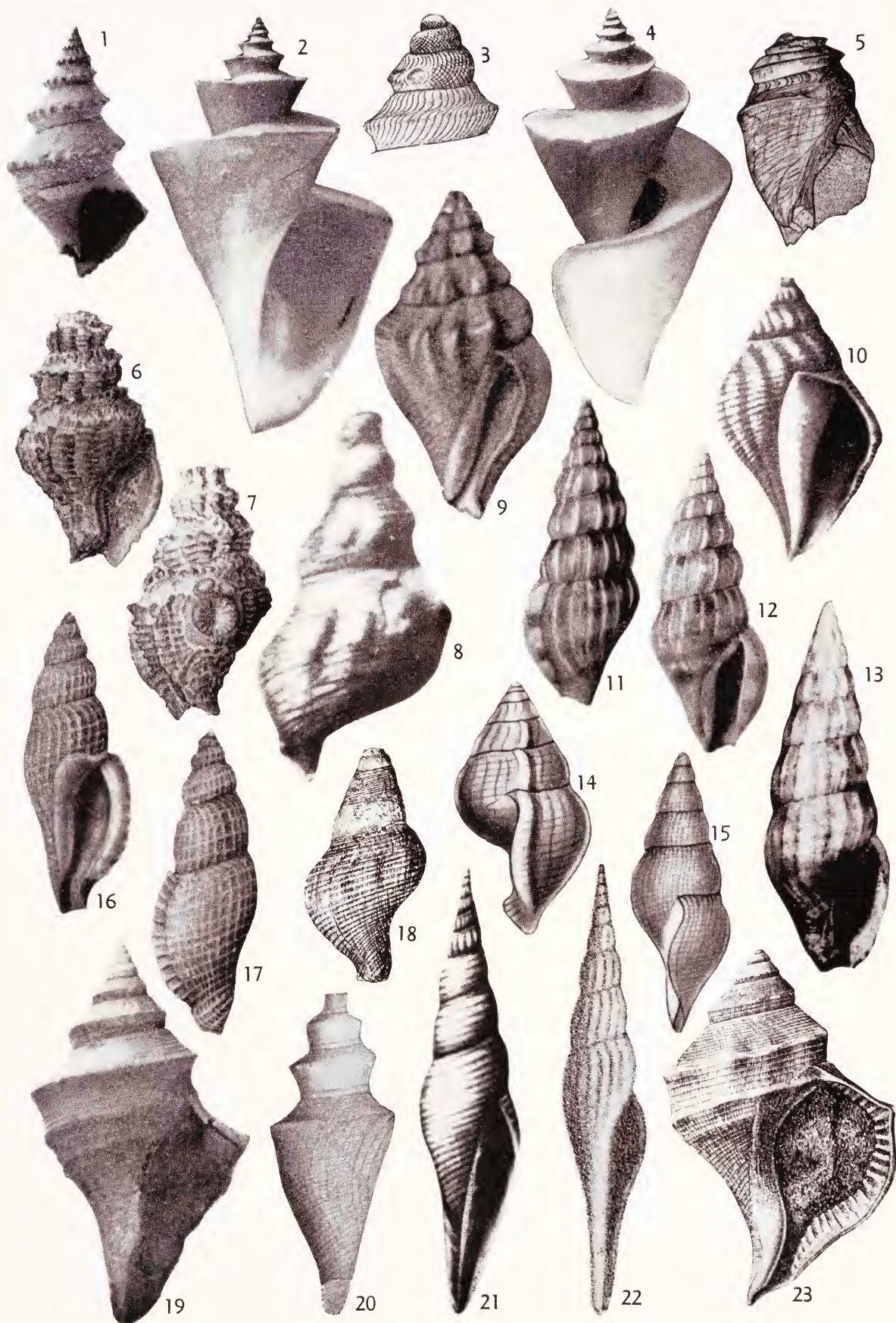






















### **ERRATA**

Page 26, right column, two lines up, read "broadly".

Page 48, left column, four lines down, read "1839-40".

Page 67, right column, ten lines down, read "MITROLUMNA".

Page 73, left column, four lines down, read "1839-40".

Page 95, left column, four lines down, read "Tschalkar".

Page 95, right column, 17 lines down, read "the pillar has a".

Page 113, left column, 27 lines down, read "Inner lip".



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